Amendment To The Record of Decision Declaration

Site Name and Location

Arrowhead Refinery Superfund Site
St. Louis County
Hermantown, Minnesota

Statement of Basis and Purpose

This decision document amends the selected remedial action for the Arrowhead Refinery Superfund Site (Arrowhead) developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This amendment to the Record of Decision (AROD) makes fundamental changes to the remedy selected in the 1986 Record of Decision (ROD).

This AROD does not make "fundamental changes" (within the meaning of the Environmental Protection Agency's Office of Solid Waste and Emergency Response Directive 9355.3-02FS-4, "Guide to Addressing Pre-ROD and Post ROD Changes", April 1991) to the groundwater remedy selected in the ROD. Therefore, this AROD does not constitute an amendment of that groundwater remedy. However, this AROD does document minor differences in the groundwater remedy which the Agency intends to implement.

This AROD is based on the administrative record file for the Arrowhead Site.

The State of Minnesota, through the Minnesota Pollution Control Agency (MPCA), has verbally concurred with the amended remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this AROD, may present an imminent and substantial endangerment to the public health, welfare and/or the environment.

Description of the 1986 ROD Remedy

The site contaminated media were originally divided into three parts: 1) groundwater, 2) sludge, filter cake and oil saturated peat (source material) and 3) contaminated soils and sediments.

The 1986 ROD specified that the following remedial actions be implemented:

- Extend the nearby municipal water system to replace private

water supplies to ten residences most likely to be affected by groundwater contamination from Arrowhead. Abandon individual wells formerly used as drinking water supplies in accordance with state well codes.

- Design and install a groundwater extraction and treatment system to capture and restore the contaminated groundwater beneath the site and to prevent off-site migration of the contaminated plume. Discharge extracted contaminated groundwater to the Western Lake Superior Sanitary District waste water treatment facility (WLSSD). Potential ingestion of on-site groundwater has an excess lifetime cancer risk of 10^{-2} for either a residential or a commercial/industrial setting. Operate the extraction and treatment system until 10^{-6} lifetime cancer risk levels are achieved (estimated at 25-50 years).

- Excavate and incinerate on-site, 4,600 yds^3 of source material and 20,500 yds^3 of contaminated soils and sediments with concentrations of carcinogenic Polynuclear Aromatic Hydrocarbons (PAHs) and Volatile Organic Compounds (VOCs) that exceed the 10^{-6} excess lifetime cancer risk in a commercial/industrial setting and/or concentrations of lead and other non-carcinogens that exceed adult chronic acceptable intake levels (AIC). Determine the leaching characteristics of the resulting ash. If the ash is non-hazardous by the EP toxicity test, place it back on-site. If hazardous, stabilize and place in a subtitle D landfill.

- Conduct further field studies to enhance site characterization. In response to a request from the Minnesota Pollution Control Agency (MPCA), the ROD stated that the technologies eliminated early in the FS - vitrification, chemical fixation, and cementation - would be reevaluated and that bench-scale studies would be considered.

The total cost of this remedy was estimated at $23,000,000 in 1986.

The groundwater remedial design and construction have been completed. Minor changes in the operation and maintenance of the extraction and treatment system, which do not constitute fundamental or significant changes, including point of compliance and cleanup levels, are discussed.

Explanation of Fundamental Remedy Change

EPA conducted a solvent extraction study which indicated that this technology would not be a suitable technology for the Arrowhead Site. MPCA and the Minnesota Arrowhead Site Committee (MASC), a group of PRPs, each conducted treatability studies in an effort to find a less costly alternative to incineration for both source

material, soils and sediments. Technologies evaluated included solid phase and slurry phase bioremediation, stabilization/solidification, soil washing with lead removal, thermal destruction in a cement kiln or other boilers and industrial furnaces, and chemical dissociation with lead recovery. With respect to the source material, the results of these studies indicated that chemical disassociation of source material would be the optimal method of remediation. This technology removes lead from the source material and provides a saleable "off-spec" fuel. Additionally, the lead may be recovered in a smelting operation.

Another very important discovery resulting from these studies was that as soil samples were obtained and analyzed, PAH and VOC levels were consistently found to be below health based levels of concern. This was verified in a separate field sampling study conducted in June 1993. Upon review of the early field studies, it was found that there were only two PAH "hot spots" in the soil and that these were likely due to cross contamination with filter cake. As a consequence of these findings, the soil and sediment contaminant of concern is now only lead. Therefore, treatment technologies which targeted organic compounds in soils and sediments, including incineration, have been discounted from further consideration.

Description of Amended Remedy

The major elements of the selected amended remedy include:

- Excavation of sludge and filter cake using a visually contaminated standard; total volume approximately 4,600 - 6,100 cubic yards.

- On-site treatment of sludge and filter cake by chemical disassociation (re-refining) of the toxic compounds within the sludge/filter cake matrix to produce a saleable "off-specification" fuel and to recover lead in a smelting operation or to stabilize and place in a permitted RCRA Subtitle D facility.

- Excavation of visually contaminated soils and sediments, followed by placement of soils and sediments in a permitted RCRA Subtitle D facility.

Discussion of Change in Groundwater Remedy

- Operation and maintenance of the groundwater extraction and treatment system until groundwater at the site perimeter meets Maximum Contamination Limits (MCLs).

Statutory Determinations

The selected remedy is protective of human health and the environment, attains Federal and State requirements that are

applicable or relevant and appropriate for this remedial action and is cost effective. This remedy satisfies the statutory preference for remedies that employ treatment that reduces mobility, toxicity or volume (MTV) as a principle element and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent possible.

Because this remedy will not result in hazardous substances remaining on-site above health-based levels, the five-year review will not apply to this action.

__V__ Approved _____ Disapproved

Regional Administrator Edward A. Allen

Date 2/9/94

AMENDMENT TO THE RECORD OF DECISION

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION
ARROWHEAD REFINING COMPANY SITE
ST. LOUIS COUNTY
HERMANTOWN, MINNESOTA

1.0 INTRODUCTION

1.1 Executive Summary: Record of Decision, 1986

The Arrowhead Refinery Site (Arrowhead) was included on the National Priorities List (NPL) in October 1983 with a score of 43.75. The United States Environmental Protection Agency tasked CH_2M Hill to conduct a Remedial Investigation/Feasibility Study (RI/FS) at Arrowhead. The RI/FS was conducted to determine the extent of contamination by identifying types, quantities and locations of contaminants, and subsequently, to evaluate alternatives for solving those problems associated with the site.

The RI, commenced May 1984, found volatile organic compounds (VOCS), polynuclear aromatic hydrocarbons (PAHs), carcinogenic polynuclear aromatic hydrocarbons (cPAHs), petroleum hydrocarbons (TPH), and metals in the source material, soils and sediments. In addition, the pH of the source material was found to be between 1 and 2. The RI/FS report was completed along with a Public Health Risk Assessment (PHA) in August 1986. The PHA stated that if no action were taken to remedy the site, use or development of the site would result in unacceptable health effects on user populations. The PHA also determined that there was a future potential exposure risk for off-site drinking water wells across the road from the site and in the pathway of the contaminated groundwater plume. The FS evaluated various remedial alternatives before recommending a preferred alternative for the Arrowhead site. EPA issued a Record of Decision (ROD) in September 1986, which is included in Appendix A. The major components of remediation specified in the 1986 ROD are listed below:

- Extend the nearby municipal water system to replace private water supplies to ten residences most likely to be affected by groundwater contamination from Arrowhead. Abandon individual wells formerly used as drinking water supplies in accordance with Minnesota state well codes.

- Design and install a groundwater extraction and treatment system to capture and restore the contaminated groundwater beneath the site and to prevent off-site migration of the contaminated plume. Discharge extracted contaminated groundwater to the Western Lake Superior Sanitary District waste water treatment facility (WLSSD). Potential ingestion of on-site groundwater has an excess lifetime cancer risk of 10^{-2} for either a residential or

a commercial/industrial setting. Operate the extraction and treatment system until 10^{-6} lifetime cancer risk levels are achieved (estimated at 25-50 years).

- Excavate and incinerate on-site, approximately 4,600 yds^3 of source material and approximately 20,500 yds^3 of contaminated soils and sediments with concentrations of carcinogenic Polynuclear Aromatic Hydrocarbons (PAH's) and Volatile Organic Compounds (VOC's) that exceed the 10^{-6} excess lifetime cancer risk in a commercial/industrial setting and/or concentrations of lead and other non-carcinogens that exceed adult chronic acceptable intake levels (AIC). Determine the leaching characteristics of the resulting ash. If the ash is non-hazardous, place it back on-site. If hazardous, stabilize and place in a RCRA Subtitle D landfill.

- Conduct further field studies to enhance site characterization. In response to a request from the MPCA, the ROD stated that technologies eliminated early in the FS - vitrification, chemical fixation, and cementation - would be reevaluated and that bench-scale studies would be considered.

The total cost of this remedy was estimated at $23,000,000 in 1986.

The groundwater remedial design and construction have been completed. Minor changes in the operation and maintenance of the extraction and treatment system, which do not constitute a fundamental or significant changes, including point of compliance and cleanup levels, are discussed.

1.2 Subsequent Action

The MPCA did not initially concur with the ROD to incinerate source material, soils and sediments on-site. In response to their concerns, EPA specified in the ROD that additional groundwater and soil sampling be performed to better define the extent of contamination, and in response to a request by the State of Minnesota, stated that technologies eliminated early in the FS - vitrification, chemical fixation and cementation, would be reevaluated. Consideration would be given to doing bench scale studies.

Further field sampling was conducted in 1987 and 1988 and is summarized in a report, Field Design Investigation, Arrowhead Refinery Site (FDI), April 30, 1990. Additional contaminated soils were discovered, bringing the total volume to over 40,000 yds^3. With the increase in soil volumes, and also making other adjustments, the cost estimate was recalculated at $49,000,000 - $55,000,000. The soil volume estimate has since been further refined through additional sampling. The current contaminated

soil and sediment volume is estimated at 27,000 yds^3.

In 1989, the Resources Conservation Company under EPA contract through CH_2M Hill, performed a solvent extraction treatability study on the source material and contaminated soils. The solvent extraction system performed poorly for both media. Subsequent to these findings, MPCA agreed to the 1986 ROD to incinerate the source material. MPCA felt that contaminated soils and sediments might be amenable to bioremediation. EPA agreed to fund a limited study to investigate bioremediation on soil only. In 1991, MPCA, under a cooperative agreement with EPA, conducted a bench scale biotreatability study on soils only (having agreed with EPA to thermal destruction of source material.) The MPCA biotreatability study found that organic contamination in site soils may be amenable to biodegradation through a slurry phase process. The MPCA later confirmed this finding in an addendum study.

The Minnesota Arrowhead Site Committee (MASC), a group of PRPs, also conducted investigations for alternative remedies.

In 1991, MASC undertook a treatability study to demonstrate that the Arrowhead soil and source material were amenable to biodegradation via a solid phase composting technology. This study was successful in destroying VOC's and 3- and 4-ringed non-carcinogenic PAH's in soil and source material; however, questions remained as to whether the solid phase process would also destroy the larger, five- and six-ringed carcinogenic PAHs in site soils. This study was generally much less successful in treating the source material than soil, as was expected because of the very difficult nature of the source material. Solid phase biotreatment of source material necessarily resulted in a very substantial increase in volume, and exacerbated the lead leaching characteristics of the media by liberating lead compounds previously bound up in the oily matrix. Because of these problems, bioremediation as a potential alternative was dropped from further consideration. Results of this study were submitted to EPA in March 1993 and are included in the Administrative Record.

One very important discovery took place as a result of the numerous soil samples collected and analyzed for the treatability studies. The concentration levels of carcinogenic PAH's (cPAHs) in the site soil samples consistently fell below the health-based cleanup levels corresponding to a 10^{-3} commercial/industrial future use scenario. Upon review of the RI and FDI, EPA and MPCA decided to take additional samples to confirm the presence or absence of cPAHs in Arrowhead soils. Both the RI and FDI contained only one sample with cPAHs above the cleanup level and that single sample may have been due to cross media contamination with filter cake. Twenty soil samples were collected in June 1993. All cPAH samples fell beneath detection limits and beneath the cleanup level

specified in this AROD.

With treatment of cPAHs in soil no longer considered necessary, bioremediation as a potential alternative to incineration was dropped from further consideration.

In 1992, MPCA conducted a soil wash/lead removal bench scale treatability study, which gave some promising but inconclusive results. EPA decided to drop this technology was dropped from further consideration on the basis of cost effectiveness, and because EPA considers the lead removal step a novel technology which it could not be determined was suitable for the type of lead found at the Arrowhead site. With the discovery that lead was the only contaminant of concern in soil, and with the decision to forgo soil washing/lead recovery, EPA and MPCA agreed to amend the soils remedy from on-site incineration to placement in a Subtitle D Landfill. MPCA agrees to this approach but has indicated a preference for pretreatment of soil prior to disposal in a RCRA Subtitle D landfill.

Throughout late 1992 and early 1993, MASC explored the option of thermally treating the source material in a cement kiln or other boiler/industrial furnace. Although this process proved unsatisfactory, MASC's search for a suitable vendor led to the discovery of 7&7 Inc. which possessed a proprietary reprocessing/re-refining technology. A treatability study was conducted during the Spring of 1993 and was presented to EPA and MPCA in August 1993. The study demonstrated that this technology is well suited to the source material. This process involves liquification, flocculation, separation and filtration unit operations, whereby lead and other metals in the source material are segregated out leaving a low lead content off-specification fuel. The lead-rich filter cake may then either be recovered for beneficial use, or stabilized and placed in a landfill. The findings of this treatability study are in the Administrative Record and have been incorporated into this AROD.

1.3 Explanation of Fundamental Remedy Change For Source Material and Soils

On the basis of recent treatability studies and additional field sampling, EPA and MPCA have identified remedies for soil and source material at the Arrowhead Refinery site that are more appropriate than the remedies selected in the 1986 ROD.

EPA has decided, on the basis of the treatability study conducted on 7&7's proprietary reprocessing/rerefining chemical disassociation technology, that the 7&7 technology will effectively achieve cleanup goals for the source material at a level that is equivalent or superior to and at a cost that is lower than on-site incineration. Reprocessing/rerefining would afford an equivalent degree of long-term effectiveness and

permanence, superior reduction in MTV, and superior short-term effectiveness (particularly with respect to short-term health risk.)

The discovery that cPAHs are below health-based levels of concern has led the EPA and MPCA to the conclusion that treatment for organic compounds in soil and sediments is unnecessary and that excavation and landfilling in a Subtitle D facility will effectively achieve cleanup goals for soils and sediments at a cost that is lower than on-site incineration. Excavation and landfilling of soils would provide an equivalent degree of long-term effectiveness and permanence coupled with superior short-term effectiveness (particularly with respect to short-term health risks.)

The fundamental change in the 1986 ROD remedy for source material, contaminated soil and sediments and the new selected remedy, described herein, is as follows:

- The source material will be excavated and re-refined rather than incinerated on-site. This process involves liquification of the source material using a petroleum-based diluent followed by precipitation of the oil-additive component inherently present in the source material. The precipitating agent will produce a floc which will trap and remove particulate impurities (carbon and lead) upon settling. The "lead free" product will be sold as off-specification fuel. The floc precipitate will be dried to produce a filter cake which will either be sent to a secondary lead recovery facility, or be stabilized and disposed of in an off-site landfill. Excavation will be conducted using a visual standard set by EPA and MPCA (the source material is jet black and very easy to distinguish from site soils and peat.) The current volume estimate of source material is between 4,600 yds^3 and 6,100 yds^3.

- The visually contaminated soils and sediments will be excavated, dried and disposed of in a Subtitle D landfill rather than incinerated on-site. Visually contaminated soil is easy to distinguish from clean soil. The current volume estimate for contaminated soil and sediment is 27,000 yds^3. Confirmatory sampling will be conducted to ensure that soils are below the lead cleanup level of 500 ppm. Soils exceeding the cleanup standard for lead of 500 ppm will be excavated and placed in a RCRA Subtitle D landfill, provided it passes the Toxicity Characteristic Leaching Procedure (TCLP). If it fails the TCLP it will have to be stabilized before placement in a landfill. Clean fill will be placed on-site in place of the excavated soils and sediments.

This amendment to the ROD does not effect the groundwater remedy selected in the 1986 ROD. EPA intends to implement the operation and maintenance of that remedy with minor differences. The

groundwater extraction and treatment system will remain in operation until groundwater contaminant concentrations inside the site perimeter no longer exceed Maximum Contaminant Levels (MCLs). Previously, the groundwater extraction and treatment system was to remain in operation until groundwater contaminant concentrations inside the site perimeter no longer exceeded specified health-based levels. As noted above, these differences do not constitute fundamental or significant changes, and so the differences do not necessitate either a formal Amendment of the ROD or Explanation of Significant Differences.

1.4 Site Location and Description

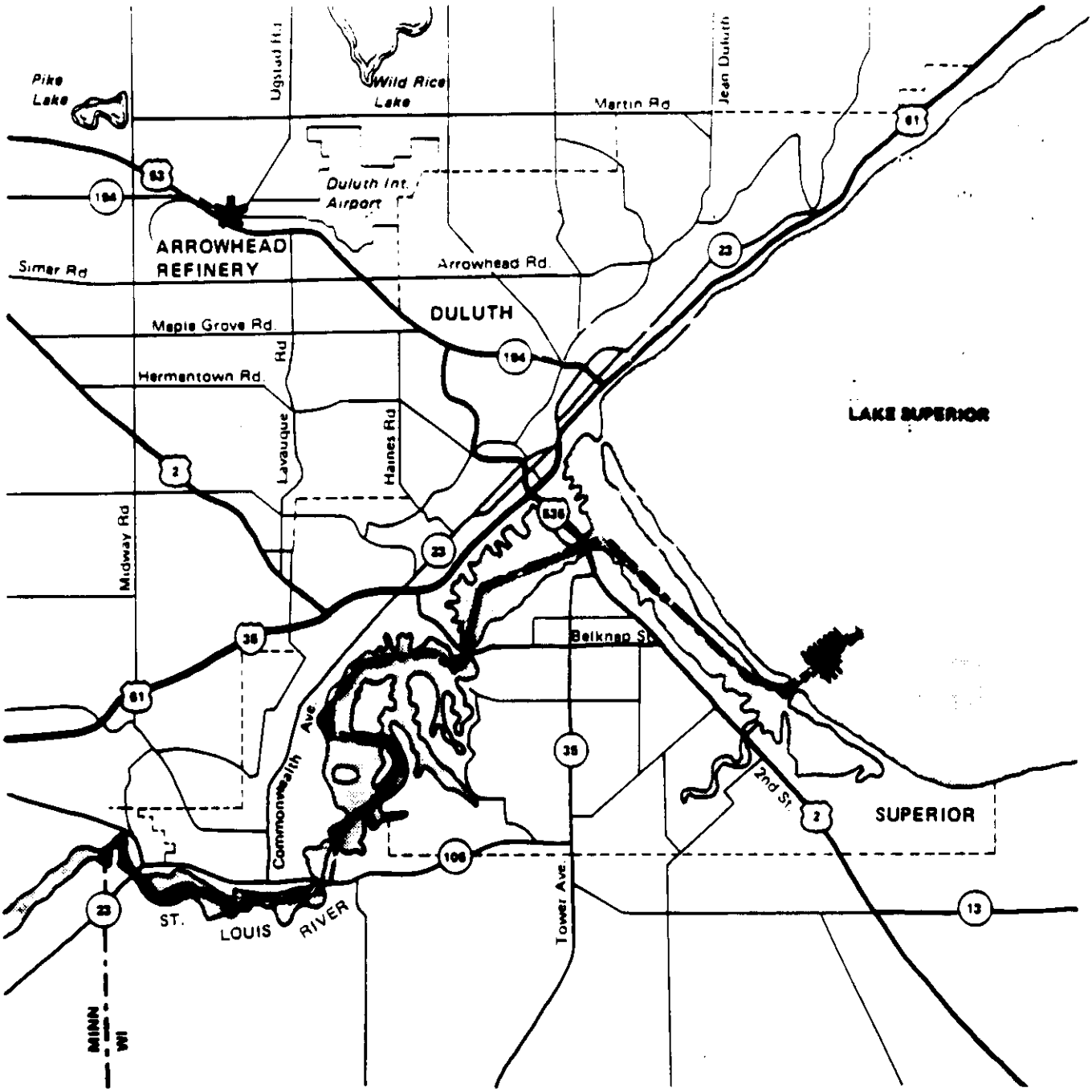
The Arrowhead Refinery site is located in Hermantown, St. Louis County, Minnesota, 8 miles northwest of the city of Duluth (Figure 1-1). The 10 acre site is bounded on the north by a U.S. EPA ditch, on the south by the Miller Trunk highway (Hwy 53); on the east by Ugstad Road; and on the west the boundary extends northward from the culvert under U.S. 53 (Figure 1-2). The area directly north and west of the site consists of heavily wooded, marshy lowland. The area around the site includes residential homes, scattered retail and commercial operations.

A two-acre lagoon filled with a black sludge and filter cake from the waste oil recycling operation is the major source area of concern at the site. There is no live vegetation in the lagoon. The remainder of the site substrate consists of fill materials and soils and sediments, much of which, in the processing area south of the lagoon, have been contaminated by waste oil spills and processing leaks (Figure 1-3 shows a general outlay of the site).

White cedar swamp stumps in and around the lagoon area, and a white cedar swamp at the north and west edges of the site indicate that white cedar swamp was the original ecosystem at Arrowhead. Dominant plant species in the swamp adjacent to the site include Northern White Cedar (Thuja occidentalis), Tamarack (Larix laricina), Black Spruce (Picea mariana), Sphagnum, Marsh Fern (Thelypterus palustris) and Cinnamon Fern (Osmunda cinnimonmea). The site outside the lagoon supports a disturbed wetland plant community in which exists a palustrine shrub-scrub and emergent wetlands of variable wetness levels (Figure 1-4).

2.0 SITE OPERATIONS AND ENFORCEMENT HISTORY

Arrowhead is the location of a former waste oil rerefining facility. According to Minnesota Pollution Control Agency (MPCA) records, the site was originally used for re-tinning milk cans and was later converted for re-refining of waste oil using an acid-clay process to extract moisture and impurities to produce a clean product. The refining process generated a waste stream of highly acidic, metal-laden sludge that was disposed of in an unlined 2-acre lagoon on the site, and waste process water that



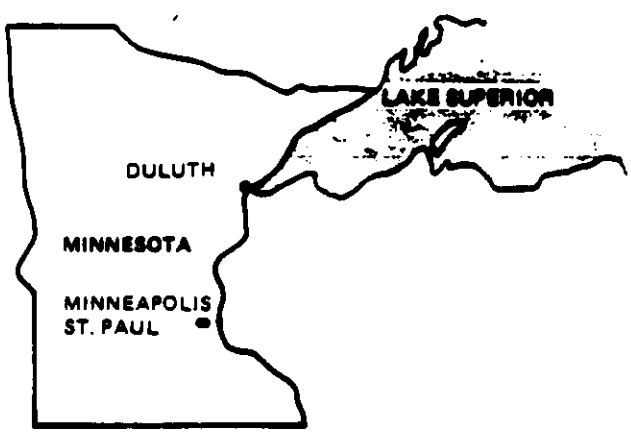


FIGURE 1-1
AREA MAP
ARROWHEAD REFINERY SITE

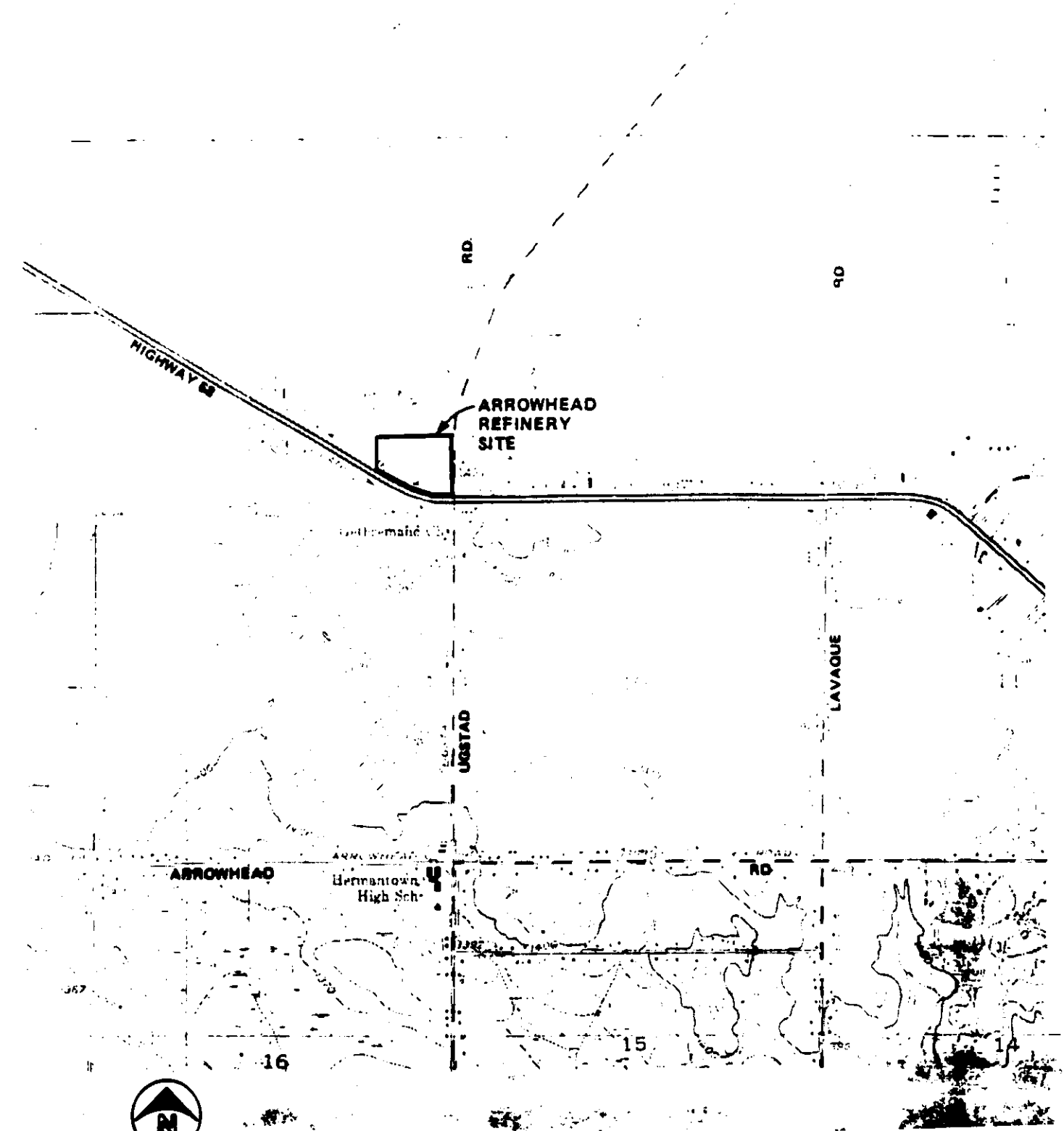
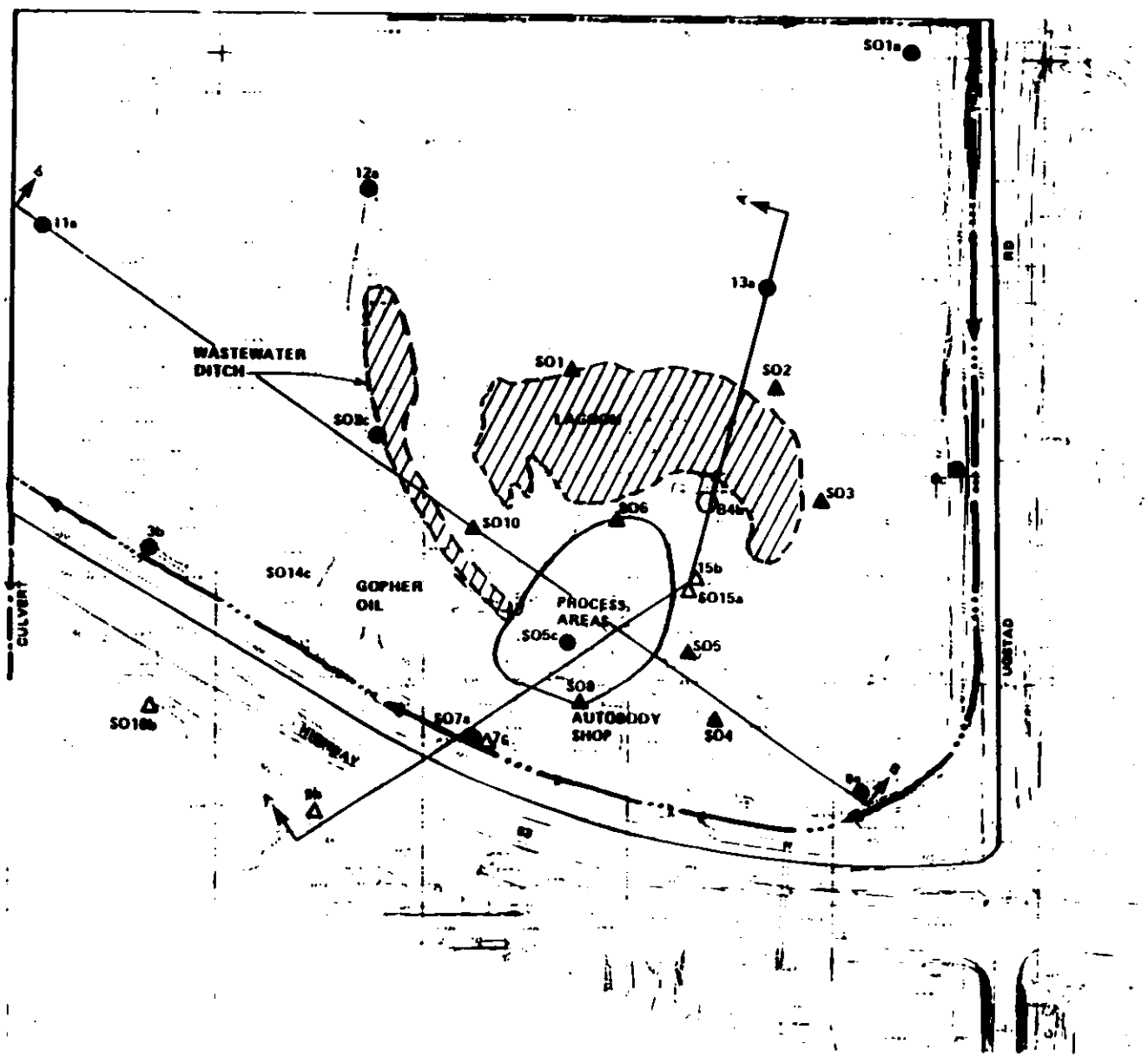


FIGURE 1-2
LOCATION MAP
ARROWHEAD REFINERY SITE



LEGEND

- EPA DITCH
- SITE BOUNDARY
- ● PHASE I SOIL BORING MONITORING WELL INSTALLED
- ▲ PHASE II SOIL BORING
- △ PHASE II SOIL BORING MONITORING WELL INSTALLED
- ⬡ WELLS FROM PREVIOUS INVESTIGATIONS

SOURCE: ARROWHEAD REFINERY RI

FIGURE 1-3
SITE MAP
ARROWHEAD REFINERY SITE

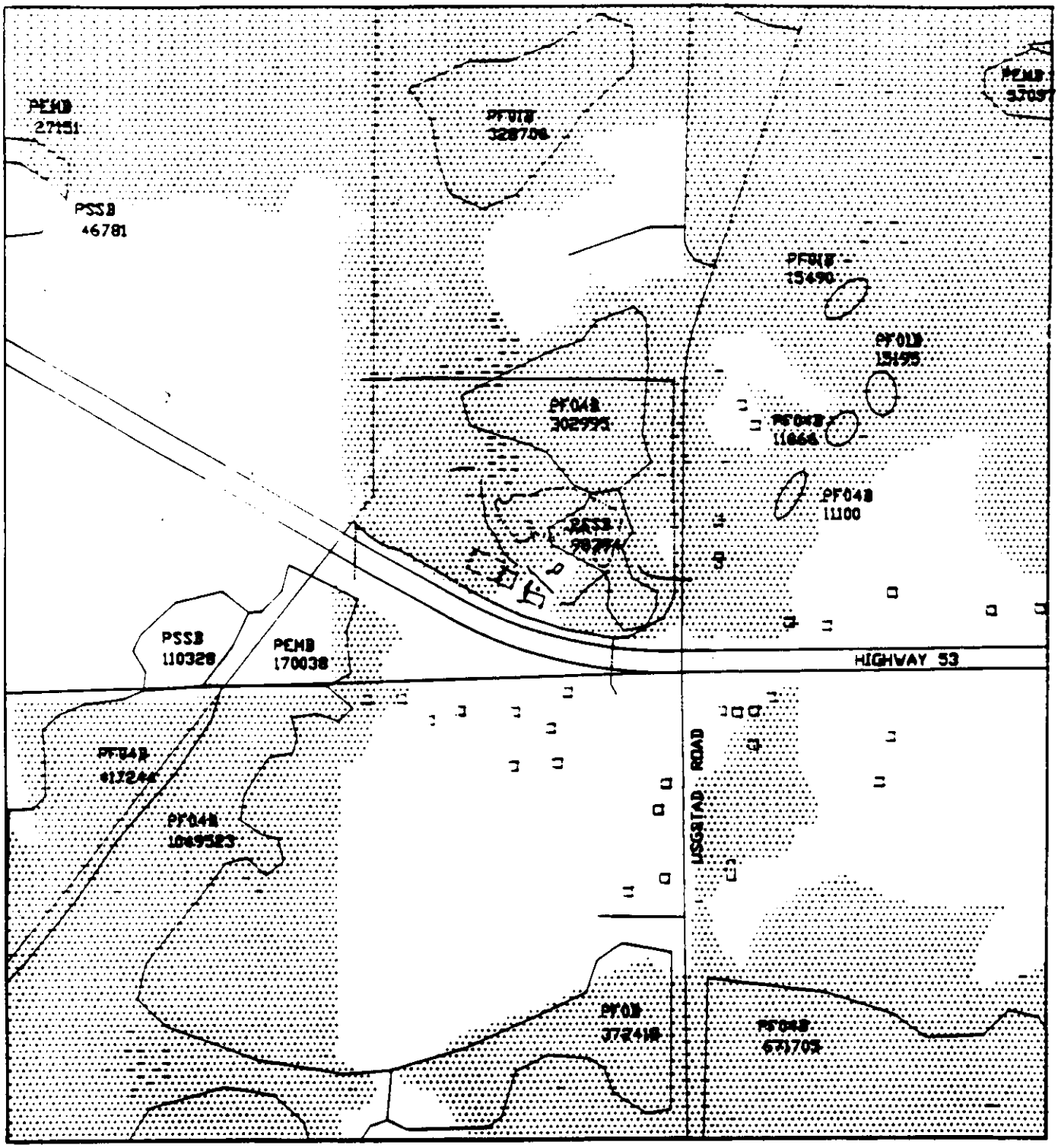


FIGURE 1-4

WETLANDS NEAR ARROWHEAD SITE

was discharged into a waste water ditch in a wetland area. Arrowhead Refining Company, incorporated in 1961, continued the re-refining activities until 1977. Arrowhead collected waste oil from businesses large and small across northern Minnesota and Wisconsin and brought it back to the site for re-refining.

In 1976, MPCA ordered Arrowhead to cease disposal of waste byproducts on the property. Arrowhead ceased operations shortly thereafter. In 1979, EPA, at the request of MPCA, investigated the environmental effects resulting from the disposal activities on-site. In 1980, U.S. EPA determined that the site was in violation of the Clean Water Act, 33 U.S.C. Section 1321, because surface water flowed through the site, transporting contaminants to a nearby wetland area and eventually into navigable waters. In response to this finding, a ditch was constructed by the U.S. Coast Guard north and east of the site to help divert surface water around the waste disposal lagoon. Five monitoring wells were also installed and limited on-site sludge and soil samples were taken. This data and subsequent sampling of the monitoring wells by the MPCA helped support the Hazardous Ranking Score (HRS) of 43.75. The site was placed on the National Priority List (NPL) in October 1983.

In 1984 EPA commenced a Remedial Investigation and Feasibility Study (RI/FS). The RI/FS report was completed along with a Public Health Risk Assessment (PHA) in 1986. Analyses of the samples collected during the RI revealed the presence of a variety of priority pollutants (including lead, PAHs, and VOCs) in the subsurface soil, sediment, groundwater and source material. The public health assessment found that if no action were taken to remedy the site, use or development of the site would result in unacceptable health effects on user populations.

On September 30, 1986, EPA signed a Record of Decision (ROD) for the site. The ROD specified thermal treatment of sludge; thermal treatment of contaminated soils and sediments; extraction and treatment of contaminated groundwater; extension of municipal water supplies to residents near the site who might be receptors of the contaminated groundwater; and implementation of a long-term groundwater monitoring program. The MPCA initially disagreed with the decision to thermally treat the source material and contaminated soil and sediment. The MPCA sought to find a less costly remedy, and further site investigation in order to refine the estimate of the extent of contamination on-site. In response to these concerns, EPA specified in the ROD that additional design investigation activities should be conducted in connection with site cleanup.

In 1987 and 1988 further field sampling was conducted which lead to a revision of the soils volume estimate from 14,400 to 40,000 cubic yards. Subsequent soil sampling has led to further

refinement of the estimate of contaminated soils to 27,000 yds^3.

In 1989 a solvent extraction treatability study was conducted on the source material and soil. The solvent extraction system performed poorly on both the sludge and soil because of the complex matrix of contaminants involved. Subsequent to the results of the treatability study, the MPCA agreed to the ROD remedy to incinerate the source material. EPA and the MPCA agreed to investigate bioremediation on the contaminated soil and sediments.

In July 1989, pursuant to section 107 of CERCLA, EPA sued 15 parties in a cost recovery action for past site investigation costs and for future site remedial costs. The defendants then filed a third party action, seeking contribution from other parties alleged to have been involved at the site. The third party action has been amended twice and includes over 250 third-party defendants.

In March 1990, EPA issued an unilateral administrative order (UAO) pursuant to CERCLA Section 106, to nine potentially responsible parties (PRPs), for the construction of the watermain extension to thirteen residents along Highway #53 and Rose Road and the construction of a groundwater extraction and treatment system. The UAO was amended in November 1990 to include three additional parties. In response to the UAO, the PRPs formed the Minnesota Arrowhead Site Committee (MASC). MASC agreed to undertake the work specified in the UAO. The Hermantown watermain extension and residential connections were completed during the 1990 construction season. Construction of the groundwater extraction and treatment system was completed in June 1993.

In May 1990, following the issuance of the groundwater UAOs and following verbal concurrence by the MPCA to the remedy for the source material, EPA issued special notice letters pursuant to Section 122(e) of CERCLA to over 140 parties, for implementation of the source material remedy selected in the 1986 ROD. Subsequent efforts to negotiate between EPA, MPCA and MASC were not successful in producing an agreement to conduct the source material remedy.

In May 1991, EPA issued a UAO to approximately 150 PRPs to conduct the source material remedy as specified in the ROD. Following the issuance of this UAO, MASC membership increased to over 40 parties. MASC began implementation of the source material UAO, conducting pre-remedial design activities from 1991-3.

MASC also independently conducted treatability studies in an effort to find a less costly remedy, as stated above. Although MASC did not conduct these studies under a formal agreement with EPA, EPA reviewed and approved a quality assurance project plan to

assure that the data would meet the Agency's data quality standards. EPA agreed to review final treatability study reports submitted by MASC.

In 1992 MASC conducted an independent pilot-scale bioremediation treatability study on Arrowhead source material and soil. A final report was submitted to EPA and the MPCA in March 1993. The treatability study demonstrated that contaminated soil, but not source material, might be suitable for bioremediation.

In 1993 the MPCA conducted a bench scale soil washing study. MASC conducted a source material re-refining treatability study which produced very promising results. MASC submitted the study to EPA and the MPCA in August 1993.

Upon review of the soil sample analyses generated both by MASC and MPCA from these treatability studies, and with confirmatory sampling and analysis conducted in June 1993, EPA and the MPCA concluded that lead was the only contaminant of concern which existed in soil above health-based levels. This information has prompted EPA to amend the ROD remedy for soils and sediments from on-site incineration to disposal in a RCRA Subtitle D landfill.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

There has been significant participation from the community and the City of Hermantown since the issuance of the 1986 ROD, related to Arrowhead site issues (see MDH Site Health Assessment for specific health-related discussion).

During the 1990 construction season, EPA, MPCA and MASC attended several City Council meetings to obtain permission to extend the Hermantown Municipal Watermain to residents living along Highway 53 north of Lavaque Bypass and along Rose road.

In April 1990, EPA, MPCA, and the Minnesota Department of Natural Resources held a meeting with Canosia township residents at the local high school to discuss the effects of the Arrowhead groundwater extraction and treatment system on residential well levels in the neighboring communities.

The Proposed Plan of amendment for the Arrowhead site was released to the public on October 13, 1993. It was made available to the public for review in the administrative record, located at the City of Hermantown offices, at the Duluth Public Library and EPA Region V headquarters. A notice of public meeting was published in Duluth on October 13, 1993, and individual notices were mailed to residents associated with or living near the site. A public comment period was held from October 13, 1993 to November 13, 1993. In addition to the invitation for public comments and the accessibility of the site information, a public meeting was held on October 27, 1993 at the Hermantown City High school. At this

meeting, representatives from EPA and the MPCA answered questions and addressed community concerns regarding the Proposed Plan of Amendment. Responses to comments received during the public comment period are included in the Responsiveness Summary, Appendix C of this Amended Record of Decision.

4.0 SITE CHARACTERISTICS

A detailed discussion of the site geology, hydrogeology and the nature and extent of contamination of the site may be found in the 1986 ROD which is appended, and in the Remedial Investigation and the Field Design Investigation which are both part of the Administrative Record. Below is a brief review of the site characteristics.

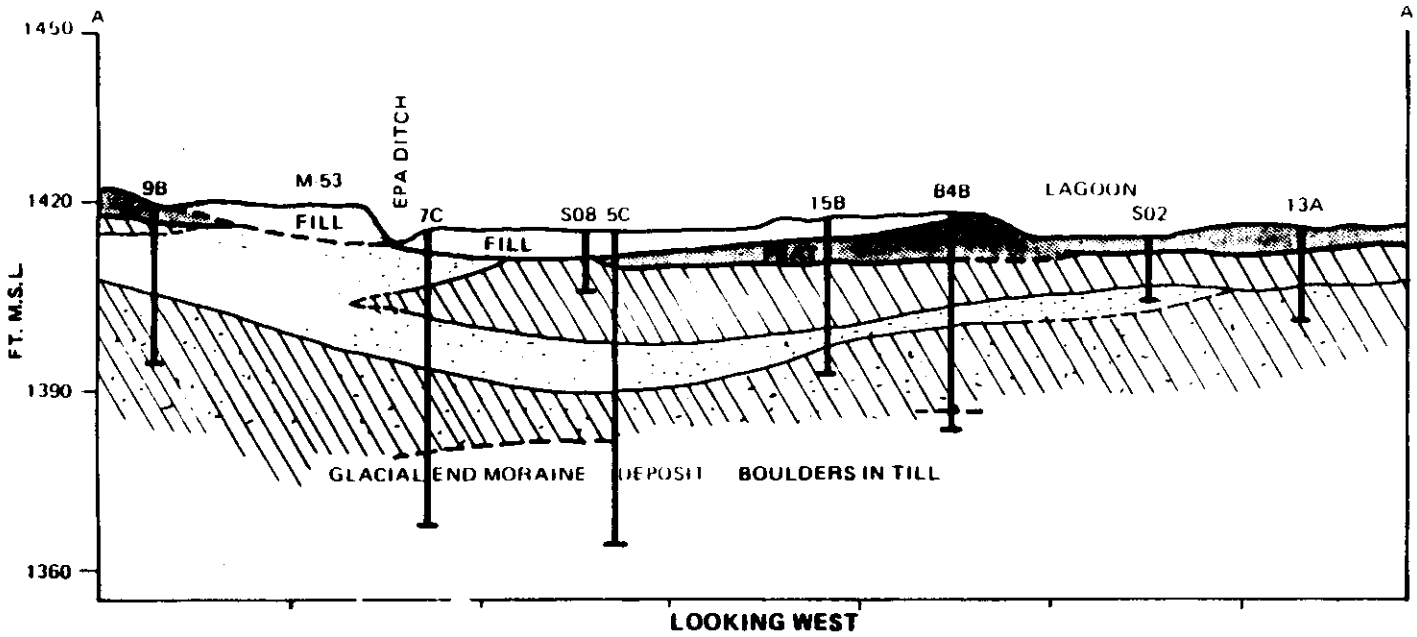
4.1 SITE GEOLOGY

The subsurface geology is divided into four units: fill, peat and clay, morainal deposits, and bedrock. The fill material consists of loose to dense dark brown or black sand, silty sand, or sandy silt, and is gravelly in some areas. The fill extends from the southern end of the boundary of the lagoon to Highway 53 and east to the wastewater ditch and the Gopher Oil building. On-site the fill ranges from zero to seven feet in thickness. The peat is a brown to black fibrous, moderately decomposed organic material that ranges in thickness from zero to eight feet. The peat is continuous across the site except in the southern portion. Clay lies beneath the peat, is gray, blue gray, green, or yellow brown and is zero to five feet in thickness. The clay is continuous throughout the site except near the auto body shop. A morainal deposit underlies the peat and clay. This deposit consists of 30 to 53 feet of mixed glacial outwash and till that is made up primarily of brown silt, sandy silt or clayey silt. Depth to bedrock ranges from 25 to 60 feet. Figure 4-1 shows a generalized cross section of the site.

4.2 SITE HYDROGEOLOGY

The Arrowhead Refinery site is in a watershed of the Midway River (Figure 4-2). The natural surface water drainage from the site is to the southwest toward the wetland area that is adjacent to Rocky Run Creek, a tributary of the Midway River. The Midway River then joins the St. Louis River, which empties into Lake Superior.

Water levels beneath the site are zero to four feet below ground surface in the fill-peat-clay unit. Flow in the unit is toward the southwest (Figure 4-3). In November 1987, the horizontal gradient was calculated to be 0.0052 ft/ft. Mean vertical gradients range from -0.02 ft/ft to -0.4 ft/ft. The logarithmic average of the hydraulic conductivity was calculated to be 4.3 x 10^{-4} cm/s and the average groundwater velocity was calculated to be



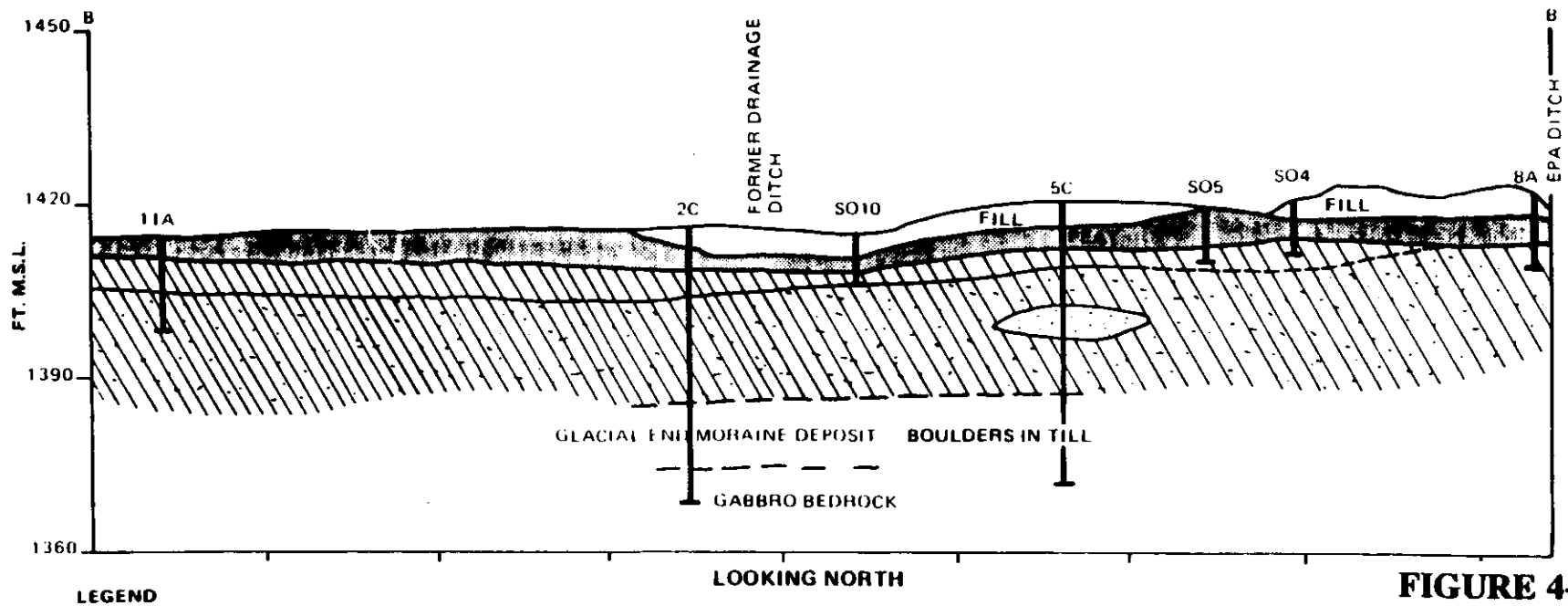
NOTE

The depth and thickness of the subsurface strata indicated on these sections were generalized from and interpolated between test borings. Information on actual subsurface conditions exists only at the specific locations and dates indicated. Soil (rock) conditions and water levels at other locations may differ from conditions occurring at the boring locations. Also, the passage of time may result in a change in the conditions at these boring locations.

LEGEND

S08 BORING/WELL NUMBER

BOTTOM OF BORING



SCALE IN FEET

HORIZONTAL 1 [illegible]

VERTICAL 1 [illegible]

LEGEND

Glacial Outwash Deposits

- SILT AND CLAY
- SAND AND GRAVEL
- INTERBEDDED CLAY, SILT, SAND AND GRAVEL

— — INFERRED CONTACT

SOURCE: Arrowhead Refinery RI

FIGURE 4-1

GENERALIZED GEOLOGIC CROSS SECTIONS

ARROWHEAD REFINERY

FIELDWORK DESIGN INVESTIGATION

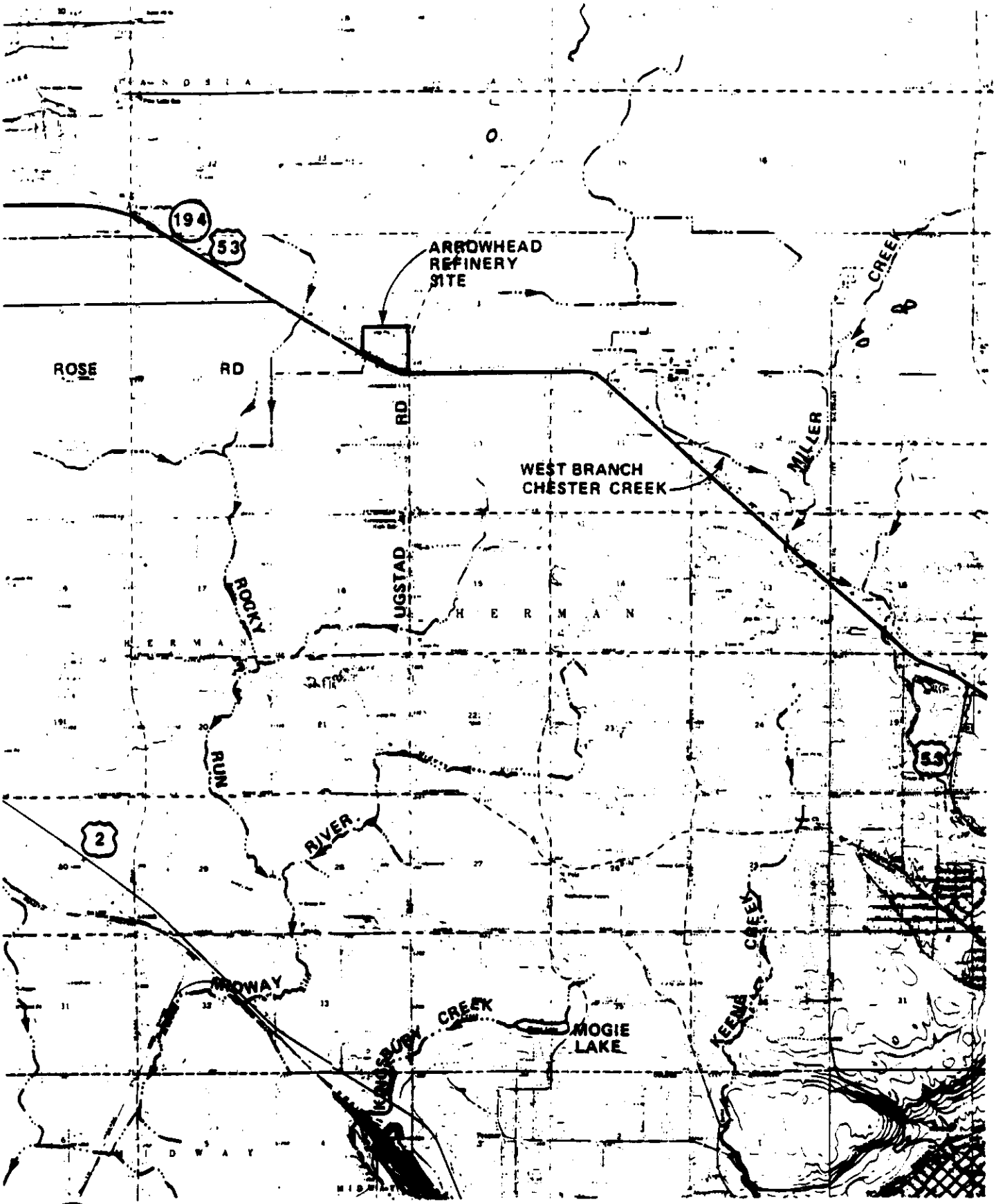


FIGURE 4-2
ARROWHEAD REFINERY
SURFACE WATER
ARROWHEAD REFINERY
FIELDWORK DESIGN INVESTIGATION

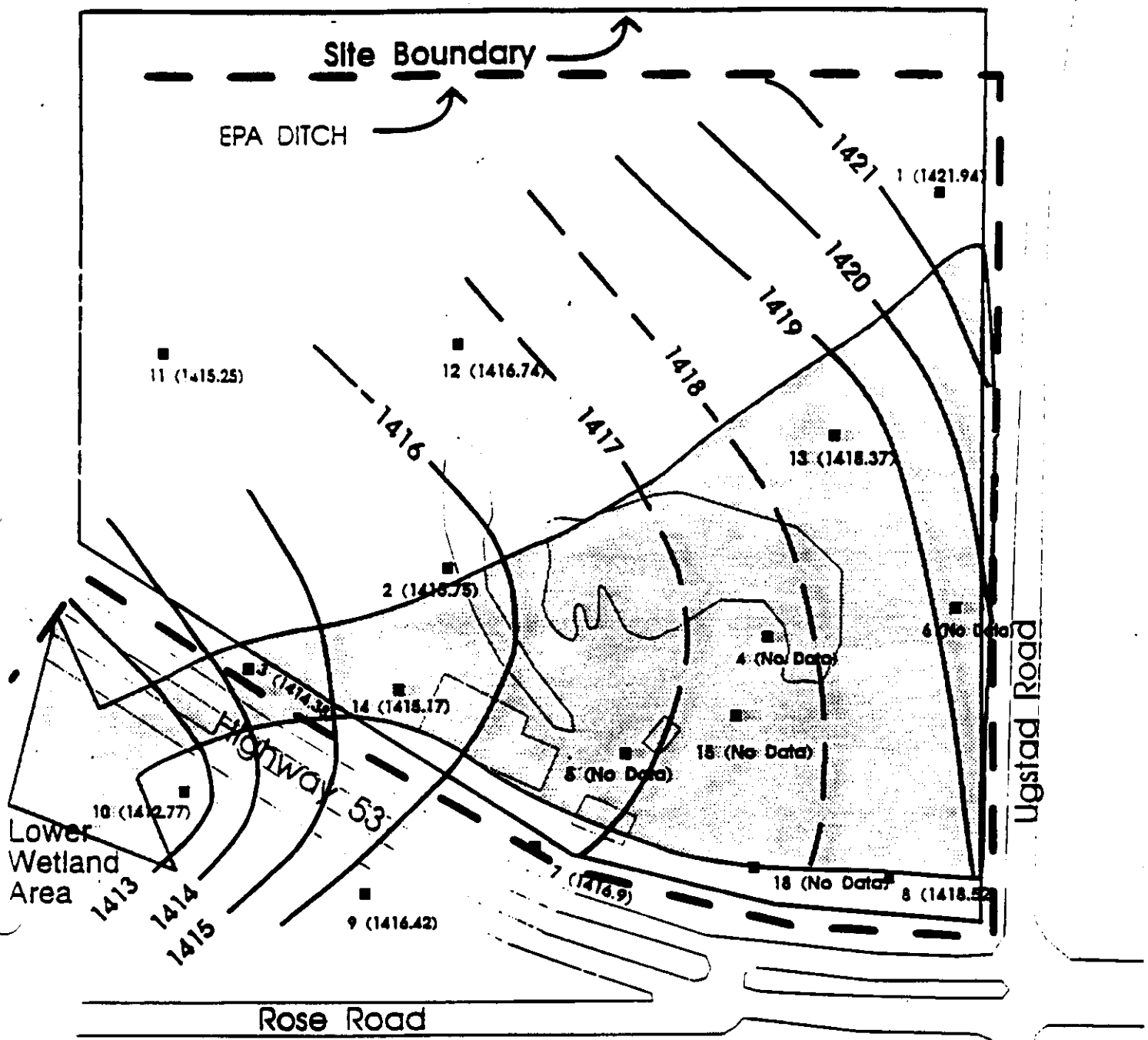


FIGURE 4-3
SURFICIAL GROUNDWATER FLOW

■ Monitoring Well Nest

10 (1412.77) Location Number and Groundwater Elevations on 8/16/87

N

200 Feet

0.04 ft/day.

4.3 NATURE AND EXTENT OF CONTAMINATION

Source Material

The source material in the lagoon consists of approximately 4,600 - 6,100 cubic yards of liquid sludge, filter cake and oil saturated peat. The source material is highly acidic with pH values of 1. Results of the RI and FDI show that lead levels average around 1% and are as high as 2.35%. However, treatability study sampling suggest that lead levels might be significantly higher (analytical interference and lead binding to organic compounds may have lead to an underestimation of the lead content.) The source material contains elevated levels of carcinogenic PAHs, Phenolic compounds PCB's, BETX compounds (benzene, toluene and xylenes) and chlorinated compounds (Table 4-1).

TABLE 4-1
Source Material Contaminants

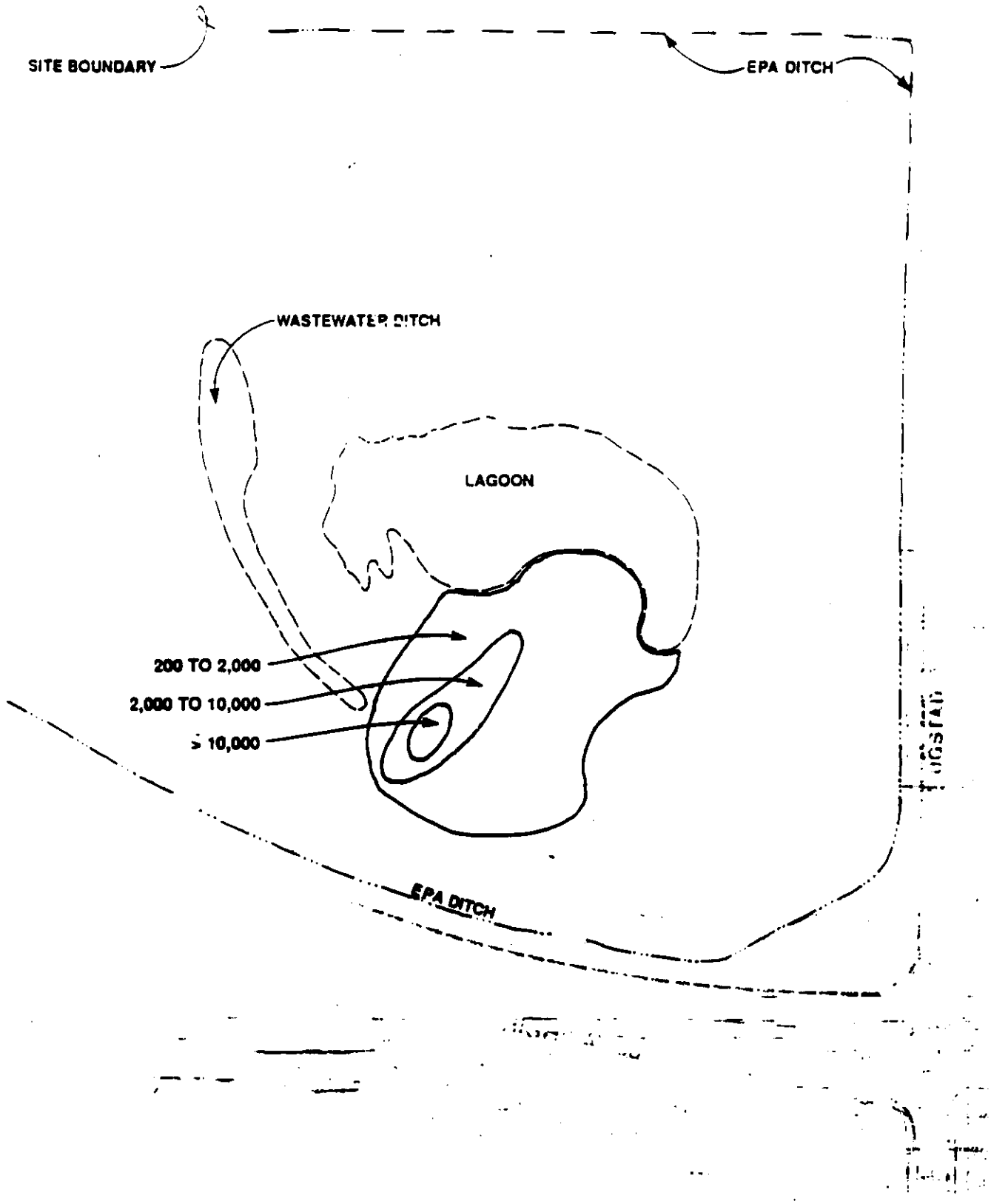
COMPOUND	MAX CONC (mg/kg)	Sample Date
VOLATILE ORGANIC COMPOUNDS		
benzene	430	8/8/85
2-butanone	27,000	8/8/85
1,1-dichloroethene	9,800	8/8/85
methylene chloride	22,000	8/8/85
1,1,1-trichloroethane	440	8/8/85
trichloroethene	410	8/8/85
SEMI-VOLATILE ORGANIC COMPOUNDS		
bis(2-ethylhexyl)phthalate	55	4/27/88
dimethylphthlate	42	4/27/88
2-methylnaphthalene	130	4/27/88
phenanthrene	36	4/27/88
4,4-DDD	38	4/27/88
4,4-DDT	96	4/27/88
INORGANIC COMPOUNDS		
aluminum	22,600	4/27/88
beryllium	1.1	8/8/85
cobalt	9.8	8/8/85
lead	23,500	4/27/88
magnesium	6,720	4/27/88
nickel	75	4/27/88
potassium	1,030	8/8/88
vanadium	65	8/8/85
zinc	4,300	4/27/88

Soils and Sediments

The fill and peat layers are visually contaminated with oil over most of the process area (Figure 4-4). Sampling results from the RI and FDI indicate that lead levels in visually contaminated soils and sediments average 2000 ppm and range as high as 1.2 %. VOC's and cPAHs were also detected during the RI and FDI (Tables 4-2,3). Subsequent sampling indicate that the cPAH "hot spots" may have been due to cross contamination with filter cake.

TABLE 4-2
On-Site Soil Contaminants

COMPOUND	MAX CONC (mg/kg)	Sample Date	Cleanup* Criteria (mg/kg)
VOLATILE ORGANIC COMPOUNDS			
benzene	0.6	5/31/85	1,974
2-butanone	0.43	6/3/85	1.23E6
carbon tetrachloride	64	6/1/85	440
chloroform	2.4	6/1/85	2.04E4
1,2-dichloroethane	310	11/5/84	629
4-methyl-2-pentanone	0.015	5/19/88	1.02E5
methylene chloride	21	6/1/85	1.23E5
1,1,2-trichloroethane	0.011	11/5/84	8,176
trichloroethene	2.5	11/5/84	5,203
SEMI-VOLATILE ORGANIC COMPOUNDS			
benzo(a)anthracene	39	5/15/85	78
benzo(a)pyrene	21	5/15/85	8
benzo(b)fluoranthene	35	5/15/85	78
benzo(k)fluoranthene	35	5/15/85	784
benzo(hgi)perylene	10	5/18/85	
bis(2-ethylhexyl)phthalate	2.1	6/1/85	4088
butylbenzylphthalate	1.9	5/18/85	4.09E5
chrysene	20	5/18/85	784
dibenz(a,h)anthracene	4.7	5/18/85	8
dibenzofuran	4.4	5/18/85	6176
dimethylphthlate	3.3	6/2/85	2.04E7
2,4-dinitrotoluene	1.7	5/18/85	64
fluorene	15	5/15/85	8.20E4
2-methylnaphthalene	2.8	5/18/88	
naphthalene	22	6/2/85	
phenanthrene	85	5/15/85	
phenol	0.39	5/18/88	1.22E6
pyrene	46	5/15/85	6.13E4
INORGANIC COMPOUNDS			
aluminum	8,997	10/7/84	
antimony	51	5/31/85	



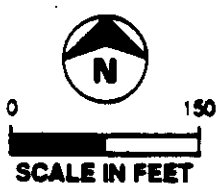


FIGURE 4-4
DISTRIBUTION OF LEAD IN FILL (mg/kg)
ARROWHEAD REFINERY
FIELDWORK DESIGN INVESTIGATION

beryllium	7.8	5/31/85	
cobalt	21		
copper	24	10/7/85	
lead	12,078	11/5/84	500**
lithium	20	7/7/85	
magnesium	10,600	5/18/88	
mercury	0.6	5/18/88	
nickel	83	10/7/85	
potassium	2,720	5/17/88	
tin	289	5/17/88	
vanadium	70	5/17/88	
zinc	875	6/2/85	

* Based on commercial/industrial use scenario: 10^{-5} risk for carcinogens, and HI = 1.0 for non-carcinogens.
** Lead cleanup criteria based upon OSWER Directive # 9355.4-02, "Interim Guidance on Establishing Lead Cleanup Levels in Soil", September 1, 1989.

TABLE 4-3
On-Site Sediment Contaminants

COMPOUND	MAX CONC (mg/kg)	Sample Date	Cleanup* Criteria (mg/kg)
VOLATILE ORGANIC COMPOUNDS			
1,2-dichloroethane	0.005	8/6/85	629
4-methyl-2-pentanone	0.010	8/6/85	1.02E5
1,1,1-trichloroethane	0.032	8/6/85	1.63E5
trichloroethene	0.055	8/6/85	5,203
vinyl chloride	0.010	8/6/85	30
SEMI-VOLATILE ORGANIC COMPOUNDS			
benzo(a)anthracene	0.350	8/6/85	78
benzo(a)pyrene	0.330	8/6/85	8
butylbenzylphthalate	0.330	8/6/85	4.09E5
chrysene	0.340	8/6/85	784
4-methylphenol	0.330	8/6/85	
naphthalene	6.6	8/6/85	
phenanthrene	6.6	8/6/85	
INORGANIC COMPOUNDS			
aluminum	27,300	8/6/85	
beryllium	1.7	8/6/85	
cobalt	35	8/6/85	
lead	1,220	8/6/85	500**
magnesium	12,200	8/6/85	
nickel	71	8/6/85	
potassium	806	8/6/85	
tin	24	11/8/84	

vanadium	91	8/6/85
zinc	1,630	8/6/85

* Based on commercial/industrial use scenario: 10^{-5} risk for carcinogens, and HI = 1.0 for non-carcinogens.
** Lead cleanup criteria based upon OSWER Directive # 9355.4-02, "Interim Guidance on Establishing Lead Cleanup Levels in Soil", September 1, 1989.

Groundwater

Concentrations of inorganic and organic constituents found in on-site monitoring wells are presented in Table 4-4. Site related MCLs are exceeded on-site for lead, benzene, 1,2-dichloroethane, 1,1-dichloroethylene, trichloroethylene, and vinyl chloride. Residential wells were found to be free of site related contaminates.

TABLE 4-4
Maximum Concentration of all Compounds
Detected in Groundwater

COMPOUND	MAX. CONC. (ug/L)	Sample Date	MCL/HRL(RAL) (ug/L)
VOLATILE ORGANIC COMPOUNDS			
acetone	8,800	12/7/84	-/700
benzene	3,700	5/4/88	5/10
bromoform	0.7	8/4/85	100/40
2-butanone	1,100	12/7/84	-/(300)
chlorodibromomethane	10	8/4/85	100
chloroethane	50	6/6/85	
chloroform	130	8/4/85	100/60
1,1-dichloroethene	25	6/6/85	7/6
1,2-dichloroethane	12.	5/4/88	5/4
1,3-dichlorobenzene	10	6/5/85	600/-
ethylbenzene	870	5/4/89	700
methylene chloride	500	5/10/88	-/(50)
tetrachloroethene	0.234	5/4/88	5/(7)
toluene	5,100	5/4/88	1000/-
total xylenes	6,000	5/4/88	10,000
trans-1,2-dichloroethene	3,500	6/6/85	100
1,1,1-trichloroethane	1.3	11/18/87	200/-
trichloroethene	650	12/6/84	5/(30)
vinyl chloride	110	11/17/82	2/(0.1)
SEMI-VOLATILE ORGANIC COMPOUNDS			
1-methylnaphthalene	570	5/10/88	
2,4-dimethylphenol	100	6/6/85	-/100
2-methylnaphthalene	58	5/10/88	
2-methylphenol	100	6/6/85	-/30
4-methyl-2-pentanone	2,100	12/7/84	

4-methylphenol	400	12/7/84	
acenaphthylene	120	5/10/88	-/400
benzoic acid	2,000	12/7/84	-/30,000
benzyl alcohol	10	6/6/85	
bis(2-ethylhexyl)phthalate	111	11/18/87	6/-
bromodichloromethane	29	8/4/85	-/6
butylbenzylphthalate	48	6/6/85	100
di-n-butylphthalate	10	6/6/85	
di-n-octylphthalate	10	6/5/85	
dimethylphthalate	18	6/5/85	
n-nitrosophenylamine	10	6/6/85	
naphthalene	350	5/4/88	-/(30)
phenol	400	12/7/84	-/(4000)
pyrene	10	12/4/84	-/(200)
INORGANIC COMPOUNDS			
aluminum	418,000	6/6/85	5/-
antimony	451	6/6/85	6/1
arsenic	877	6/6/85	50/0.2
barium	358	11/10/87	2000
beryllium	33	6/6/85	4/0.08
boron	324	7/7/85	-/600
cadmium	222	6/6/85	5/4
calcium	556,000	6/6/85	
carbon disulfide	25	6/6/85	-/700
chromium	290	6/6/85	100
cobalt	618	6/6/85	-/(1)
copper	523	6/6/85	
cyanide	41	6/6/85	200/100
fluorene	44	5/10/88	-/300
iron	3,800,000	6/6/85	
lead	722	6/6/85	15/(20)
lithium	20	7/7/85	
magnesium	1,190,000	6/6/85	
manganese	84,300	6/6/85	-/100
mercury	0.8	11/18/87	2/(1)
nickel	1,280	6/6/85	100
potassium	319,000	6/6/85	
silver	266	6/6/85	-/30
sodium	197,000	6/6/85	
strontium	202	7/7/85	
thallium	10.4	11/16/87	2/(3)
vanadium	505	6/6/85	-/(20)
zinc	295,000	6/6/85	

ug/L = micrograms per liter
a = Shallow Monitoring Well
b = Intermediate Depth Monitoring Well
c = Deep Monitoring Well
e = Bedrock Monitoring Well
r = Residential Well
MCL = Maximum Contaminant Level - regulatory contaminant concentration that EPA deems protective of public health considering the technical feasibility and

economics of water treatment.
HRL = Health Risk Limits - regulatory contaminant concentration that the Minnesota Department of health deems protective of public health.
RAL = Recommended Allowable Limit - health based guidelines developed by the Minnesota Department of Health for contaminants in private drinking water supplies (RALs are superceded by HRLs where both exist for a single contaminant).

5.0 SUMMARY OF SITE RISKS AND CLEANUP GOALS

CERCLA directs that the Agency must protect human health and the environment from current and potential exposure to hazardous substances at Superfund sites. In order to assess the current and potential risks for the Arrowhead Site, a risk assessment was conducted as a part of the RI/FS and revised in conjunction with the FDI. Cleanup goals are based in part on the risk assessment in which acceptable health based contaminant concentrations are developed. The basis for these calculations may be found in the risk assessment. Cleanup goals can also be established on the basis of ARARs, and site-specific application of policy and guidance.

The 1986 ROD defines contaminated media as media in which "the concentration of at least one contaminant at a level known to cause cumulative excess lifetime cancer risks exceeding 10^{-6} in a commercial/industrial setting and/or exceeding the adult chronic acceptable intake (AIC) for non-carcinogens."

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action in the ROD, as amended by this AROD, may present an imminent and substantial endangerment to public health, welfare or the environment.

5.1 HUMAN HEALTH RISKS

A risk assessment for the Arrowhead site, conducted by EPA, determined that there are potential risks to public health from drinking contaminated groundwater, and from dermal contact and ingestion of the contaminated soils and source material at the site. A copy of the risk assessment is available for public review at the Duluth Public Library and at the U.S. EPA, Chicago Regional Office. The risk assessment should be consulted for in-depth details on risks to public health from the site. A qualitative ecological risk assessment, conducted on September 16, 1993, is also included in the repository and in the Administrative Record.

The source material is considered heavily contaminated. The source material is also considered an acute ecological risk to local flora and fauna.

The excess lifetime cancer risks from ingestion, dermal absorption and inhalation of site soils and sediments is 1 x 10^{-5} based on a commercial/industrial exposure scenario. Non-carcinogenic risks were estimated to exceed the hazard index (HI) of 1 in the process area. The HI on the process area was estimated to be 5.5 for soil ingestion and 1.59 for dermal absorption of soil. An HI greater than 1 is considered an unacceptable risk to human health.

Groundwater underlying the site contains a number of VOC's and lead in excess of MCLs. VOC's which exceed MCLs include benzene, 1,2-dichloroethane, 1,1-dichloroethene, trichloroethene, and vinyl chloride. As the groundwater extraction and treatment system is operational and no fundamental change from this system is contemplated, risks associated with groundwater consumption will not be discussed in this AROD. A full discussion of site risks associated with ingestion, dermal absorption and inhalation of the groundwater may be found in the FDI.

5.2 ECOLOGICAL RISKS

An ecological risk assessment was conducted in September 1993. It was qualitative and focused mainly on the toxic effects of the site contaminants on the wetland flora and fauna.

Source Material

For environmental risk assessment, the nature and extent of contamination determine the receptors and ecosystems of concern. The source material contains the highest concentrations of contaminants, and is highly viscous and tacky. Both the waste's low pH and physical properties pose an acute (short-term) threat to any biota which might come into contact with the material. The lagoon contains hazardous materials, yet wildlife might mistake the lagoon for a small pond. Given the direct contact threat posed by this waste, it poses an attractive wildlife nuisance, and the receptors of concern associated with the lagoon are both terrestrial and aquatic birds as well as any other vertebrates which can penetrate the site fence. Invertebrates and vegetation cannot colonize the substrate.

The presence of cedar stumps and absence of recolonizing vegetation provides clear evidence of the waste's negative impact on biota. Wildlife which alights on the sludge may be unable to free itself from the material because it is viscous and tacky, resulting in death. The toxic properties of the material would hasten death even for animals which escape. Birds are unable to fly with oil-coated feathers, and oil-coated fur and feathers lose their insulating properties.

In addition, the destructive effect of acids on tissue are well known. The speed and degree of tissue damage depend on

concentration; however, dilute solutions of sulfuric acid causes dermatitis and other adverse symptoms to human skin. For comparison, laboratory technicians retrieving glassware from acid baths at pH 2 must wear protective gloves to avoid skin irritation. A pH 1 solution would cause intense irritation or burns of animal skin and feathers which would cause wildlife to become vulnerable to death through injury as well as water/cold stress, disease, infection and predation.

TABLE 5-1

Ontario Sediment Guidelines (values in mg/kg)

	Lowest Effect Level*	Severe Effect Level*	Process Area Average
Cu	16	110	109
Cr	26	110	74
Pb	31	250	432
Zn	120	850	1,721
PAH(total)	0.1**	550**	6.4

*The Lowest Effect Level indicates a level of contamination which has no effect on the majority of the sediment-dwelling organisms. The sediment is considered marginally polluted. The Severe Effect Level is considered heavily polluted and likely to affect the health of sediment-dwelling organisms.
**Assumes 5% Total Organic Content.

TABLE 5-2

Fill Contaminant Levels Relative To Benchmark Toxicity Values
(All values in mg/kg)

	Benchmark Levels for...		Site Fill Materials (Avg.)	
	Earthworm	Plant	Area: Process	Non-Process
Cu	643	80-800	109	ND
Cr	NA	10-500	53	ND
Pb	5941	NA	2,105	332
Zn	662	96-4000	427	331

The sludge and contaminated underlying substrates may pose an additional ecological threat via the presence of organic lead compounds, which can cause toxicity via food chain effects. This pathway is not quantitatively evaluated, however, because 1) the source material's acutely toxic properties should drive its removal; and 2) the complete lack of living organisms there means that the lagoon won't provide predators with a continuous food

source.

Finally, a comparison of the levels of lead and PAHs with the ecological benchmarks presented for evaluation of fill material provides ample evidence that contaminant levels in the source material contribute to its toxicity to ecosystems.

Soils and Sediments

The fill materials are present as both aquatic and terrestrial ecosystems. Since contaminants are not at levels which pose an acute wildlife threat, the materials were evaluated for risk to organisms at low trophic levels such as aquatic benthic macroinvertebrates and terrestrial invertebrates and plants.

Aquatic benthic ecological risk: Benchmarks for sediment toxicity to freshwater benthic macroinvertebrates are compared with contaminant concentrations detected in the process area sediment in Table 5-1 above. Severe effect level toxicity benchmarks were exceeded in on-site sediments for lead and zinc. Lowest effect level toxicity benchmarks were exceeded for total PAHs, copper and chromium. Benchmarks were not readily available for VOCs.

Terrestrial Ecological Risk: For evaluation of direct toxicity in the upland fill areas, soil benchmarks of toxicity to earthworms and plants are compared with fill material in Table 5-2 above. Note that the benchmarks presented here are not comprehensive and are generally used only for an indication of the potential toxicity of a soil.

Soil contaminant levels on-site are below (earthworms) or at the low end (plants) of the toxicity benchmarks presented above.

Off-site groundwater migration: Currently site run-off is collected; therefore off-site migration was not addressed in the ecological risk assessment.

5.3 CLEANUP GOALS

The source material presents the most acute threat to human health and the environment on-site. The entire volume of source material is hazardous waste by the RCRA characteristics of corrosion and leachability for lead. This waste must be rendered non-hazardous.

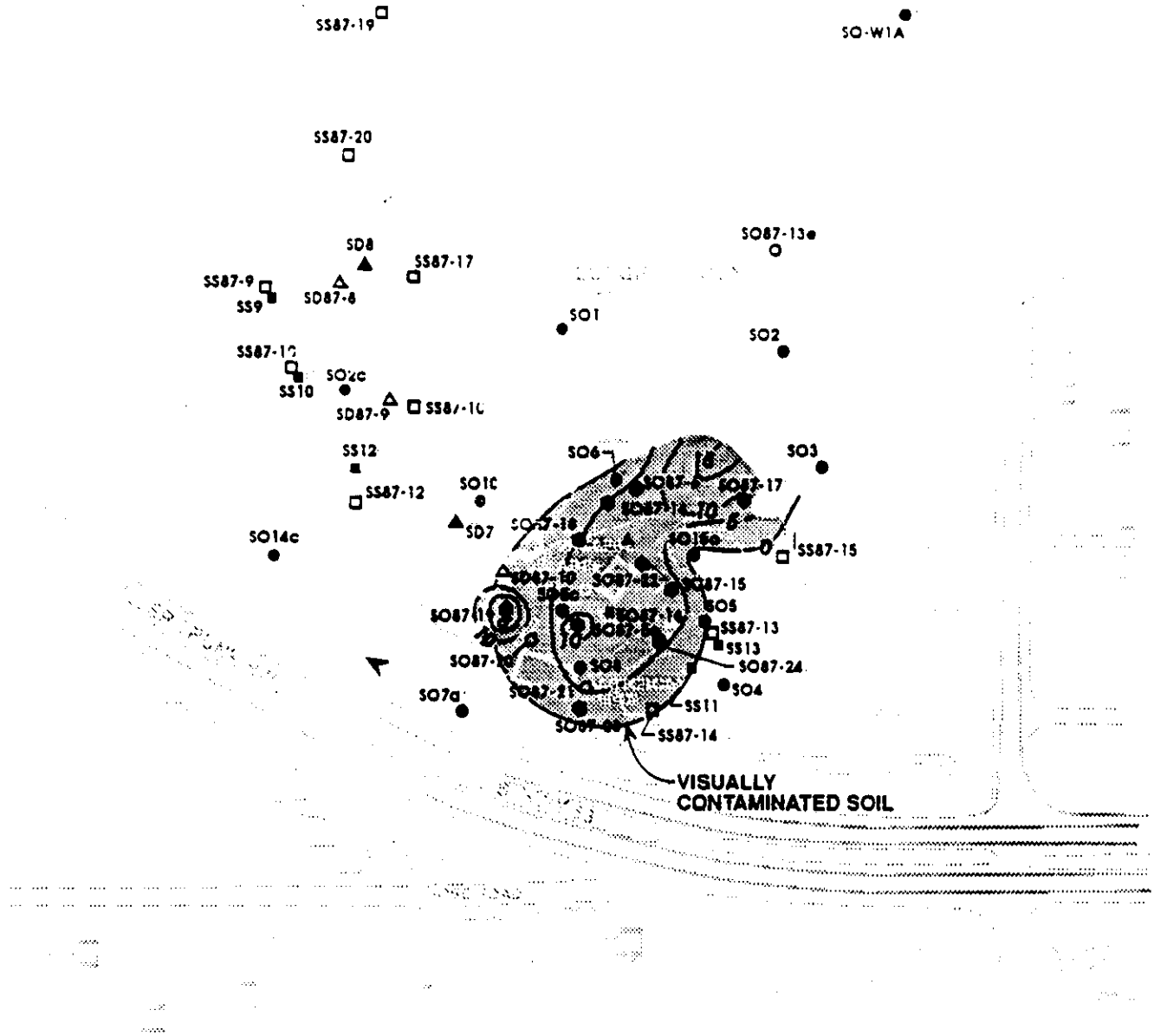
The RI and ROD set forth an estimate of non-carcinogenic risk due to ingestion of a toxicant in soil by comparing a calculated intake rate (based on site specific concentrations coupled with assumptions regarding soil ingestion rates) to the AIC for the toxicant. When this ratio (also called the hazardous index or HI) exceeds one, the risk is considered unacceptable.

The AIC for lead, published in the U.S. EPA guidance, "Superfund Public Health Evaluation Manual (SPHEM), (1985), and set forth in the 1986 ROD, is 0.098 mg/day. Coupled with the standard assumption of 0.1 g/day soil ingestion, the original lead in soil cleanup level was 980 ppm. The lead AIC was back-calculated for soil from the drinking water MCL for lead by utilizing an assumed lead leaching rate from soil to water. EPA no longer uses this method to set lead cleanup levels for soil.

The SPHEM was superseded by OSWER directive #9355.4-02, "Interim Guidance on establishing Soil Lead Cleanup Levels at Superfund Sites", September 1, 1989, which specifies soil cleanup levels of 500-1000 ppm. These concentrations are based upon ATSDR data which correlate ingestion of lead in soil with that of lead levels in the blood of children. A range of 500-1000 ppm was developed because there are different types of lead found at various superfund sites which are more or less mobile depending on the site. Mining sites contain lead in its least mobile form (large particles of elemental lead). The 1000 ppm level was specified for this type of site. The 500 ppm criterion was specified for sites in which lead is found in smaller particulate and more solubilized forms such as the types found at a smelter site, a plating site, or at a waste oil refinery site such as Arrowhead. The guidance states that these levels need not be considered retroactive in the event that a ROD is complete and a cleanup criterion has been set forth based upon the SPHEM. However, in the event of a ROD amendment, both ARARs and TBCs become "unfrozen", and the lead level would have to be reconsidered pursuant to any relevant post-ROD regulation, policy or guidance. Based on this guidance, EPA and MPCA have set the cleanup level for lead in soil at 500 ppm.

Cleanup levels for carcinogenic contaminants in soil have changed since 1986 with changes to the carcinogenic potency slope factors (which indicate the strengths of the individual carcinogens). Cleanup criteria for the site have been revised based on a commercial/industrial exposure scenario, and on a health risk of 1 in 100,000 or 10^{-5} rather than 10^{-6}. This was done because some of the concentrations at the site associated with a 10^{-6} risk level fell beneath analytical detection limits and were therefore impracticable as cleanup goals. Soils sampled since the FDI are free of cPAH and other carcinogenic compounds in excess of concentration levels associated with 10^{-5} risk in a commercial/industrial setting. Cleanup goals for PAHs and VOCs in soils and sediments are presented in Table 4-2.

Source material and contaminated soils and sediments will be excavated using a visual standard. The source material is jet black and easily identified against the other media at the site. The contaminated soils and sediments are also easily identified against clean fill, clay, peat and sediments. Confirmatory



LEGEND

- ● RI SUBSURFACE SOIL SAMPLING LOCATION
- ○ FDI SUBSURFACE SOIL SAMPLING LOCATION (STEP I)
- ● FDI SUBSURFACE SOIL SAMPLING LOCATION (STEP II)
- ■ RI SURFACE SOIL SAMPLING LOCATION
- □ FDI SURFACE SOIL SAMPLING LOCATION
- ▲ RI SEDIMENT SOIL SAMPLING LOCATION
- △ FDI SEDIMENT SAMPLING LOCATION
- (10) DEPTH OF VISUALLY CONTAMINATED SOIL BELOW GROUND SURFACE (CONTOUR INTERVAL = 5')

N

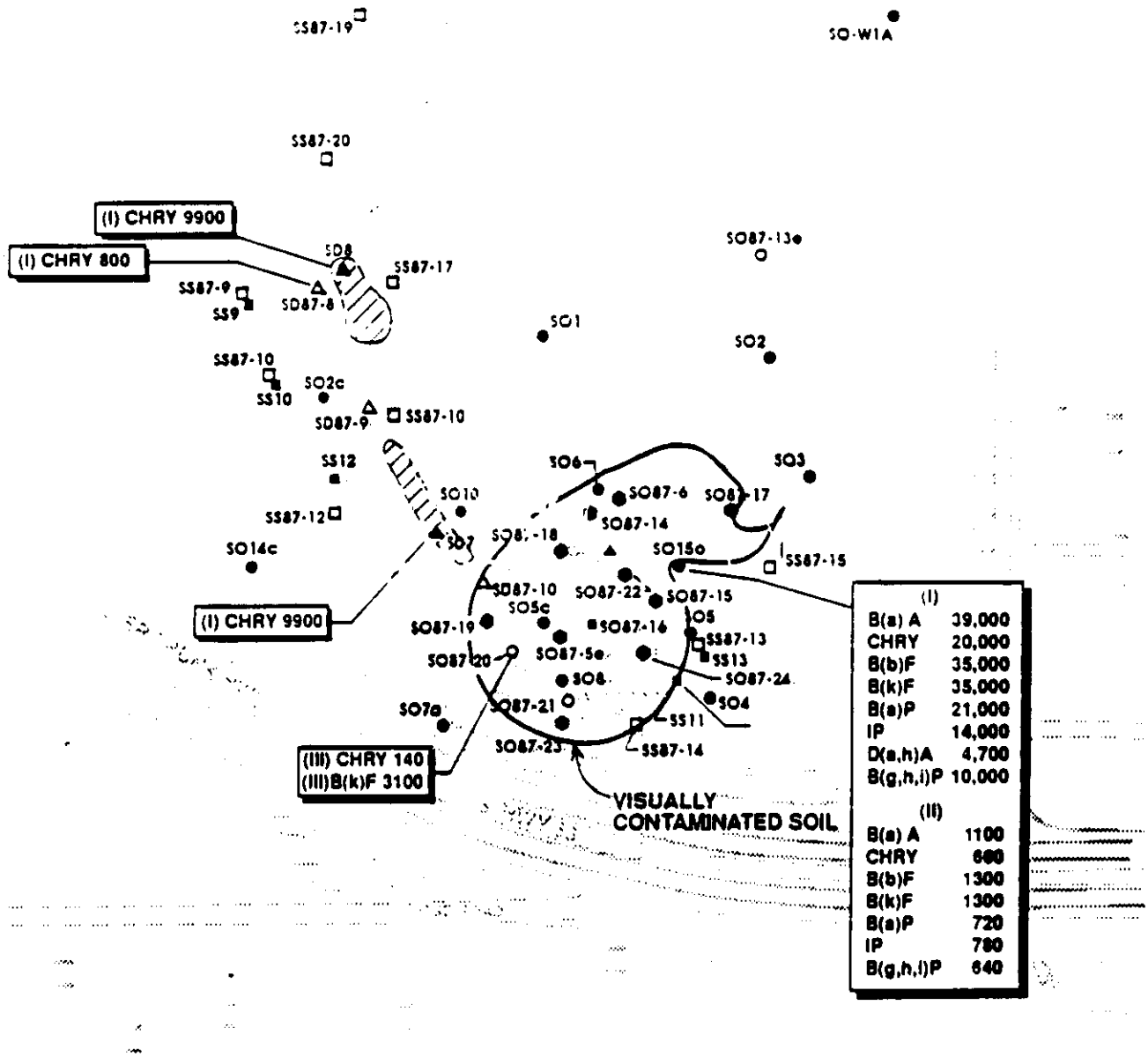
0 200'

SCALE IN FEET

FIGURE 5-1

DEPTH OF VISUALLY CONTAMINATED SOIL

ARROWHEAD REFINERY
FIELDWORK DESIGN INVESTIGATION



LEGEND

- EPA DITCH
- SITE BOUNDARY
- RI SUBSURFACE SOIL SAMPLING LOCATION
- FDI SUBSURFACE SOIL SAMPLING LOCATION (STEP I)
- FDI SUBSURFACE SOIL SAMPLING LOCATION (STEP II)
- RI SURFACE SOIL SAMPLING LOCATION
- FDI SURFACE SOIL SAMPLING LOCATION
- RI SEDIMENT SOIL SAMPLING LOCATION
- FDI SEDIMENT SAMPLING LOCATION
- FILL LAYER CONTAINING >5.7 ppm CARCINOGENIC PAHs

Layers

(I) = FILL
(II) = PEAT/CLAY
(III) = MORAINE

N

0 200'

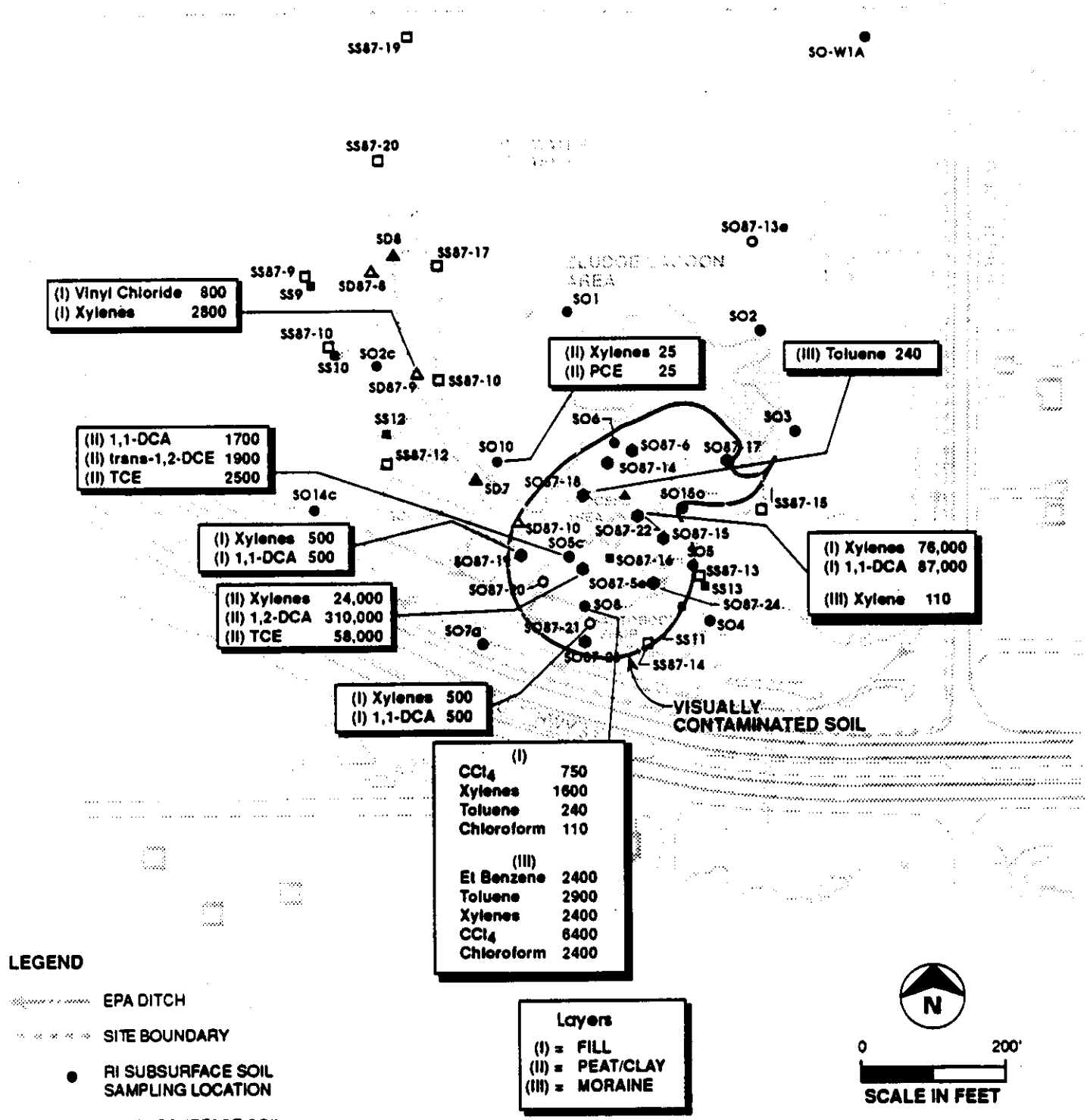
SCALE IN FEET

FIGURE 5-2

PAHs CONCENTRATIONS IN SOIL AND SEDIMENT SAMPLES (ug/kg)

ARROWHEAD REFINERY

GLE65569 DS A2 VOCs in Soil/Sed 2/7/94klmw



LEGEND

- EPA DITCH
- SITE BOUNDARY
- ● RI SUBSURFACE SOIL SAMPLING LOCATION
- ○ FDI SUBSURFACE SOIL SAMPLING LOCATION (STEP I)
- ⬢ FDI SUBSURFACE SOIL SAMPLING LOCATION (STEP II)
- ■ RI SURFACE SOIL SAMPLING LOCATION
- □ FDI SURFACE SOIL SAMPLING LOCATION
- ▲ RI SEDIMENT SOIL SAMPLING LOCATION
- △ FDI SEDIMENT SAMPLING LOCATION

NOTE: Arrows indicate direction of flow.

FIGURE 5-3

VOCs CONCENTRATIONS IN SOIL AND SEDIMENT SAMPLES (ug/kg)

ARROWHEAD REFINERY

sampling and analysis for lead will be conducted on the soils.

With the excavation of all visually contaminated soils in the processing area and sediments in the wastewater ditch, all soils and sediments with a greater than 10^{-5} carcinogenic risk and a hazardous index greater than one will be excavated, and it is expected that there will be no detectable cPAHs and VOC's left on-site (see Figures 5-1, 5-2, and 5-3).

One of the goals of the groundwater component of this remedial action is to restore the surficial aquifer to a quality consistent with its beneficial use which is for domestic use. Groundwater cleanup criteria to meet the remediation goals have been determined by examination of the Safe Drinking Water Act Maximum Contaminant Levels (MCLs) and the use of a human health risk assessment to determine contaminant concentrations which are protective of human health. EPA and MPCA have determined that once the aquifer meets MCLs, it will be safe for human consumption. MCLs are listed in Table 4-4. Also listed are Minnesota Department of Health Risk Limits (HRLs) and Recommended Allowable Limits (RALs) (HRLs supercede RALs where both exist for a single contaminant).

6.0 DESCRIPTION OF ALTERNATIVES

6.1 1986 ROD Alternatives

This AROD does not include a re-evaluation of each remedial alternative in the 1986 ROD. The alternatives evaluated in the 1986 ROD include the following:

Source material technologies:

1. No action.
2. Stabilization and transport to a RCRA Subtitle C landfill.
3. On-site incineration.

Soils Technologies:

1. No action.
2. Clean soil cover.
3. Excavation and transport to a RCRA Subtitle D landfill.
4. On-site incineration.

A complete evaluation of these alternatives are contained in the 1986 ROD found in Appendix A of this AROD.

The selected and implemented remedy for groundwater is not discussed in this analysis.

The selected remedy for soils, as specified in the 1986 ROD, was on-site thermal treatment of source material, contaminated soil and sediment, and on-site treatment or off-site disposal and treatment of groundwater. The selection of this alternative is now being reevaluated in light of new information regarding both the nature and extent of contamination at the site and alternative remediation technologies.

6.2 Alternatives Analyzed in this AROD

Based on the results of additional studies that were conducted, the following alternatives were evaluated for the site for the purposes of this AROD (please note that the groundwater extraction and treatment system will continue to operate under all of the alternative scenarios below):

Alternative No. 1: No Action on source material and soil.

Alternative No. 2: On-site incineration of source material, contaminated soils and sediments.

Alternative No. 3: On-site source material re-refining, RCRA Subtitle D landfill for contaminated soils and sediments.

Alternative No. 4: Off-site incineration of source material, RCRA Subtitle D landfill for contaminated soils and sediments.

6.2.1 Alternative 1 - No Action

The no action alternative is required by the NCP to be considered within the detailed analysis. The no action alternative provides a baseline for comparison against other alternatives. Under this modified no action alternative, the source material in the lagoon and the contaminated soils and sediments would remain in place with no institutional controls to mitigate exposure pathways of dermal absorption and inhalation to human populations or to wildlife. Contaminants would continue to leach to groundwater indefinitely necessitating the indefinite operation and maintenance of the groundwater extraction and treatment system.

6.2.2 Alternative 2 - On-site incineration for source material, contaminated soils and sediments (1986 ROD remedy).

This was the remedy selected in the 1986 ROD. Under this alternative, all source material (4,600 - 6,100 yds^3) and all visually contaminated soils and sediments would be excavated and incinerated on-site. The highly acidic source material would require a neutralizing agent such as lime to bring the pH into the

neutral range. The source material would also require a bulking agent to facilitate material handling before it could be fed into an incinerator. A mobile incineration unit would be used on-site to destroy the organic compounds found in the source material, soils and sediments.

Incinerator ash would be tested for lead leachability characteristics using the TCLP. Ash would either be placed back on-site or stabilized and placed in a Subtitle D landfill depending on whether it passed or failed the TCLP. Scrubber water would be routed to the POTW along with the contaminated site groundwater.

6.2.3 Alternative 3 - On-site re-refining for source material and placement of contaminated soils and sediments in a Subtitle D landfill.

Under this alternative, all source material would be excavated, neutralized, treated with a diluent and a proprietary chemical agent after which lead, other metals and solids would form a floc precipitate on-site. The precipitate would be filtered. The lead free oil would be sold as off-spec fuel. Lead in the filter cake would either be recovered for beneficial use in a smelting facility, or the cake would be stabilized and placed in a Subtitle D landfill. The filter cake will be tested by the TCLP method to ensure compliance with Land Disposal Regulations (LDRs).

All visibly contaminated soils and sediments would be excavated and dried on-site, and hauled to a RCRA Subtitle D landfill for disposal. The soil will be tested using the TCLP to ensure compliance with LDRs. The site would be backfilled with clean soil.

6.2.4 Alternative 4 - Off-site Incineration of source material, and placement of contaminated soils and sediments in a RCRA Subtitle D landfill.

Under this alternative, all source material would be excavated, neutralized, and transported off-site to a RCRA Subtitle C hazardous waste incinerator facility. The source material might also require a bulking agent to facilitate material handling before it could be fed into an incinerator. Incinerator ash would be analyzed using the TCLP and treated and/or disposed of in the appropriate manner.

All visibly contaminated soils and sediments would be excavated and dried on-site, and hauled to a RCRA Subtitle D landfill for disposal. The soil will be tested using the TCLP to ensure compliance with LDRs.

TABLE 6-1

Glossary of Evaluation Criteria

The NCP requires that remedial alternatives be analyzed against nine criteria. Below is a brief summary of each of the criteria. For a full description of the criteria, see 40 CFR 300.430 (e)(9)(iii).

Overall protection of human health and the environment and compliance with ARARs (unless a specific ARAR is waived) are threshold requirements which must be met in order to be eligible for selection:

- Overall Protection of Human Health and Environment - addresses whether or not a remedy provides adequate protection to human health and the environment. It addresses how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- Compliance with ARARs - addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of any Federal environmental law or State environmental of facility siting law (as required in CERCLA Section 121) and if not, whether a waiver is applicable.

The primary balancing criteria are long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost:

- Long-Term Effectiveness and Permanence - refers to the magnitude of residual risk subsequent to remediation, and to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

- Reduction of Mobility, Toxicity, or Volume - addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce the toxicity, mobility and volume of hazardous substances as a principal element.

- Short-Term Effectiveness - addresses the speed with which the remedy achieves protection, and the potential of the remedial action to create short-term adverse impacts on human health and the environment.

- Implementability - addresses the technical and administrative feasibility of a remedy, including the availability of materials and various services needed to implement the chosen solution.

- Cost - includes capital, annual and operation, maintenance and monitoring and present worth value costs. Present worth is the total cost of an alternative in today's dollars.

State and community acceptance are modifying criteria that shall be considered in remedy selection.

- Support Agency Acceptance - addresses whether the State in this case concurs with, opposes, or has no comment on the recommended alternative.

- Community Acceptance - addresses the community's comments on the recommended alternative. The Responsiveness Summary, in the appendix of the AROD, addresses comments received from the public.

7.0 EVALUATION AND COMPARATIVE ANALYSIS OF ALTERNATIVES

This section provides the basis for determining which alternative provides the best balance among the nine criteria. A glossary of the evaluation criteria is presented in Table 6-1.

7.1 Overall Protection of Human Health and the Environment

Alternatives 2, 3, and 4 are protective of human health and the environment. Risks associated with inhalation and dermal absorption of contamination are effectively mitigated by removing all contaminated media, and treating and/or containing the media so that all health and environmental risk is mitigated. The no action alternative is not protective. Risks associated with inhalation and dermal absorption of contaminated media are not mitigated. Acute environmental risks to local flora and fauna remain unabated as well.

7.2 Compliance with Applicable or Relevant and Appropriate Regulations (ARARS)

Alternatives 2, 3 and 4 can be expected to meet the respective ARARs as defined in Section 8 of this AROD. Incineration alternatives 2 and 4 are subject to more numerous and more stringent ARARs, but with monitoring during implementation, would be expected to meet ARARs. Alternative 2 would be subject to an FAA rule limiting the stack height due to proximity to the Duluth Airport. This could increase RD/RA costs. Alternative 1 does not comply with ARARs.

7.3 Long-Term Effectiveness and Permanence

Alternatives 2, 3 and 4 provide equivalent long term effectiveness and permanence. All provide complete removal of all contaminated media, and clean closure with no residual on-site risk.

Alternative 1 provides neither long term effectiveness nor permanence.

7.4 Reduction of Mobility, Toxicity or Volume

Source material:

Alternatives 2 and 4 provide for complete reduction in MTV of organic compounds. Alternatives 2 and 4 provide no reduction in volume for lead. Assuming the incinerator ash requires stabilization, these alternatives provide some reduction in lead toxicity. It is anticipated that alternative 3 will produce a saleable fuel which is ultimately burned; therefore, alternative 3 may also be considered to provide for a complete reduction in organic MTV. Assuming the lead will be recovered for beneficial use in a secondary smelting facility, this option also provides for a complete reduction in lead MTV. Should the smelting option become unfeasible for any reason, then this alternative is substantially similar to Alternatives 2 and 4 for lead. Alternative 1 provides no reduction in MTV.

Contaminated soil and sediment:

Alternative 2 may provide a reduction in mobility and toxicity of the lead which might, as part of the ash, be stabilized and placed in a landfilled. It may also provide an increase in volume because of the stabilization process. Alternatives 1, 3 and 4 provide no reduction in MTV.

7.5 Short-Term Effectiveness

Alternatives 2, 3 and 4 require excavation of source material, soils and sediment which will lead to some releases of VOC's and possibly some semivolatile compounds into the atmosphere. Air monitoring will be required during excavation and during remediation to ensure that emissions do not pose a risk greater than 10^{-4}. Alternatives 2 and 4 provide short term potential for releases of toxic emissions and residues into the environment under upset process conditions. Alternative 2, on-site incineration, poses a greater potential threat to human health and the environment than alternative 4 because of nearby residential receptors and the wetland ecology around the site. Risks to human health associated with off-site incineration are mainly in relation to site workers, since most off-site incinerators are located well away from residentially zoned areas. Alternative 3 poses minimal health risks compared to Alternatives 2 and 4 because its technology operates at ambient conditions and involves mixing/flocculation/separation steps as opposed to high temperature thermal treatment. Alternative 1 poses no remediation risks.

7.6 Implementability

All alternatives are readily implementable. Alternative 2 is somewhat more difficult than the others to implement because stringent performance standards must be demonstrated through a trial burn and maintained throughout remediation. Alternative 2 also calls for the incineration of soils and sediments which means treatment of far greater volumes of contaminated media than either alternative 3 or 4. Off-site incineration facilities are likely to be well able to handle a variety of wastes. Such facilities routinely sample incoming feed for composition and BTU content and make adjustments to processing parameters such as feed rate and dilution ratios with other types of wastes in order to meet air emissions regulations. Reprocessing, Alternative 3, performed very well in pilot scale treatability studies with Arrowhead source material, and should be easy to scale up for full scale service. This technology is currently offered by a sole supplier. Should this supplier go out of business, or discontinue the service of supplying this technology, a contingency remedy would be required. Off-site landfilling of soil is also easily implementable.

Alternative 1 is easiest to implement since no action would be required.

7.7 Cost

The cost estimates developed for this analysis include past RD/RA costs associated with the construction of the groundwater and treatment system and the watermain extension, as well as treatment remediation costs for source material, soils and sediments, and the cost of operating, maintaining, and sampling the groundwater extraction and treatment system for 30 years.

Alternative 1: $3,125,000

Alternative 2: $39,200,000

Alternative 3: $20,800,000

Alternative 4: $22,700,000

7.8 State Acceptance

The MPCA has verbally concurred with EPA on the selection of Alternative 3. MPCA has indicated a preference for pretreatment through soil washing and lead removal, if practicable, prior to landfilling the soils and sediments; however, MPCA concurs with the selected remedy of direct placement in a RCRA Subtitle D landfill.

7.9 Community Acceptance

The Hermantown community has generally shown great interest in an expeditious cleanup. Residents near the site have expressed concern over the possible health effects of on-site incineration due to emissions, and clearly regard it less favorably than either off-site incineration or reprocessing. Responses to specific comments are available in the Responsiveness Summary located in Appendix B.

8.0 SELECTED AMENDED REMEDY

EPA has selected Alternative 3 as providing the best balance of trade-offs with respect to the evaluation criteria for the source material and soils/sediments operable units. EPA has also selected Alternative 4 as a contingency remedy should Alternative 3 become unfeasible.

The major components of the selected amended remedy include:

- Excavate visibly contaminated soils and sediments with lead concentrations in excess of 500 mg/kg, approximately 27,000 cubic yards. Dry soils and sediments and transport to RCRA Subtitle D landfill. (soil will be tested by the TCLP). Sample after excavation for lead to ensure all contaminated soil and sediment has been removed.

- De-water and treat groundwater to facilitate excavation of source material; route groundwater to the french drain system (and subsequently to the Western Lake Superior Sanitary District.)

- Remove trees within the lagoon area. Grind and dispose of wood chips. Ensure that chipped wood is non-hazardous material.

- Excavate all visibly contaminated source material approximately 4,600 - 6100 yds^3.

- Pre-grind all excavated source material solids to < 1/4." Remove and dispose of any foreign objects. Liquify, neutralize and homogenize source material with a diluent and a neutralizing agents on-site. Condition with precipitating agent. Clarify and decant liquid for loading. Filter and dry solids for lead reclamation or solidification/stabilization and placement in a RCRA Subtitle D landfill.

- Backfill excavated area with clean soil. Provide for a cosmetic cover with native wetland plants.

- Prepare and implement an EPA-approved air quality monitoring plan, as well as actions needed to protect the health of nearby residents, which may include temporary relocation of residents determined by a medical doctor and/or the Minnesota Department of Health to be at significant risk from on-site activities.

- Continue to operate and monitor the groundwater extraction and treatment system until contaminant levels in ground water at the site boundary are beneath MCLs.

- Place deed restrictions on-site to ensure that the site remains zoned for commercial/industrial development only.

The total cost of this remedy is $20,800,000. In the event that the reprocessing portion of the selected remedy becomes un-implementable, a contingency remedy of off-site incineration will be conducted in its place. Other than the source material treatment process, the major components of the contingency remedy are the same as the selected amended remedy.

Major components of the contingency source material remedy of off-site incineration include:

- Remove trees within the lagoon area. Grind and dispose of wood chips.

- Excavate of all visibly contaminated source material, approximately 6100 yds^3, and place in bulk containers.

- Ship source material to RCRA Subtitle C Incinerator. Neutralize and condition source material for optimal thermal, physical and chemical processing.

- Monitor and treat/dispose of waste water and incinerator ash to comply with NPDES and RCRA requirements.

- Backfill excavated area with clean soil. Provide for a cosmetic cover with native wetland plants.

- Prepare and implement an EPA-approved air quality monitoring plan, as well as actions needed to protect the health of nearby residents, which may include temporary relocation of residents determined by a medical doctor and/or the Minnesota Department of Health to be at significant risk from on-site activities.

- Continue to operate and monitor the groundwater extraction and treatment system until contaminant levels

in ground water at the site boundary are beneath MCLs.

- Place deed restrictions on-site to ensure that the site remains zoned for commercial/industrial development only.

9.0 STATUTORY DETERMINATION

Under CERCLA Section 121, 42 U.S.C. Section 9621, EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements, are cost effective and utilize permanent treatment technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity and mobility of hazardous substances as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

9.1 Protection of Human Health and the Environment

The selected amended remedy is protective of human health and the environment because it eliminates all contaminant exposure pathways to human and ecological receptors. All visibly contaminated media will be excavated, treated and/or disposed of off-site. The site will be back-filled with clean soil. This will eliminate risks greater than 10^{-5} for carcinogenic compounds, and HI greater than 1 for toxic compounds. The groundwater extraction and treatment system will operate until MCLs are attained at the site boundary. Attainment of MCLs will assure that site risk associated with the groundwater pathway will fall within the acceptable risk range. No unacceptable short-term risks or cross-media impacts will be caused by implementing this remedy. Air monitoring will be conducted throughout the remedial action implementation phase to ensure that inhalation risks to the surrounding community remain low.

9.2 Attainment of the Applicable or Relevant and Appropriate Requirements (ARARS)

All ARARs would be met by the selected amended remedy. Remedial Actions performed under CERCLA must comply with all ARARS. These include the following:

FEDERAL REQUIREMENTS

Resource Conservation and Recovery Act (RCRA)

40 C.F.R. Part 261.24, Land Ban - The RCRA Land Disposal Restrictions (LDR) enacted in the 1984 Hazardous and Solid Waste Amendments (HSWA) require that RCRA hazardous wastes be

treated to Best Demonstrated Achievable Technology (BDAT) standards prior to placement into the land. At this site, soil and possibly filter cake from the re-refining process will have to pass the TCLP prior to disposal. Should either fail the TCLP, the material would be stabilized prior to disposal.

Clean Water Act/Safe Drinking Water Act

EPA's determination of appropriate groundwater cleanup criteria involved an evaluation of contaminant concentrations relative to available health-based standards. Such limits, including Maximum Concentration Limits (MCLS) and Maximum Concentration Limit Goals (MCLGs), Federal Ambient Water Quality Criteria (AWQC), and Section 304 of the Clean Water Act (CWA) used as prescribed in Section 121(d)(2)(b)(i) of CERCLA, are required under the Safe Drinking Water Act (SDWA) respectively and will be met at this site.

Federal Clean Air Act

The Clean Air Act (CAA) identifies and regulates pollutants that could be released during earth-moving activities associated with the excavation and treatment of source material and contaminated soils and sediments. The CAA Section 112 identifies those substances regulated under the Federal National Emission Standards for Hazardous Pollutants for which there are no applicable Ambient Air Quality Standards. The CAA is an ARAR and the regulatory standards of the CAA will be complied with during implementation of the remedy.

Endangered Species Act

The selected remedy is protective of species listed as endangered or threatened under the Endangered Species Act. Requirements of the Interagency Section 7 Consultation Process, 50 CFR Part 402, will be met. The Department of Interior, Fish and Wildlife Service, will be consulted during remedial design to assure that endangered or threatened species are not adversely impacted by implementation of this remedy. There is currently no information to indicate that the site is visited by or contains any endangered or threatened species.

National Historical Preservation Act (NHPA)

The NHPA requires that action be taken to preserve or recover historical or archaeological data which might be destroyed as a result of site activities. No information exists to indicate that the Arrowhead Refinery Site has any historic or archaeological significance.

Federal Occupational Safety and Health Administration Act (OSHA)

The selected remedial action contractor will develop and implement a health and safety program for its workers. All on-site workers will meet the minimum training and medical monitoring requirements outlined in 40 CFR 1910.

STATE REQUIREMENTS

Regulations found in the Minnesota Pollution Control Agency (MPCA) Rules:

Minnesota Environmental Response and Liability Act (MERLA)

Minn. Statutes Chapter 115B is applicable at all state superfund sites and requires that sites be remediated. This statute limits off-site disposal of hazardous waste.

Noise Pollution Control

Minn. Rules Chapter 7030 provides noise standards that must be adhered to and measurement methodologies. This rule will be applicable when remediation techniques such as excavation or the on site re-refining of contaminated soils and sediment may approach the standards provided in the rule.

Air Pollution Control

Minn. Rules Chapter 7005 contains the air quality permits.

Minn. Rules Chapter 7007 provides the requirements for air quality permits. Although permits are not required at a CERCLA site, the terms of the permit must still be met.

Minn. Rules Chapter 7009 provides the primary and secondary ambient air quality standards that have been established to protect the public health from adverse effects. Air quality will be monitored during remediation to ensure that the standards are not violated.

Minn. Rules part 7011.0150 states that reasonable measures must be taken to control fugitive dust emissions. This rule will be applicable when airborne pollutants may result from the excavation and grinding of contaminated soils. One method to avoid excess amounts of particulate matter from becoming airborne would be the application of water.

Minn. Rules parts 7005.0300 to 7005.0330 provide standards for odorous emissions that will be applicable to the excavation, and contaminated soils re-refining process.

Minn. Rules parts 7011.1201 to 7011.1207 provides regulations pertaining to incinerator operation which would become applicable should the selected remedy not prove effective and the alternative

of incineration of the contaminated materials is chosen.

Minn. Rules parts 7011.1500 to 7011.1515 provides standards of performance for petroleum storage vessels.

Minn. Rules part 7011.1520 provides standards of performance for petroleum and volatile organic liquid storage vessels.

Minn. Rules parts 7011.1800 to 7011.1820 pertains to the performance standards by reference for lead smelters. The recoverable lead from the remedial action will be taken to a lead smelter for processing if the remedial action is proven effective.

Hazardous Waste

Minn. Rules Chapter 7045 provides a list of hazardous wastes, provides detailed standards applicable to generators of hazardous waste, standards applicable to transporters of hazardous waste and land disposal restrictions. These regulations will be applicable in the case hazardous waste is generated and will need to be transported and disposed of off site. This regulation is also applicable to the storage tanks holding any hazardous wastes in the areas such as tank compatibility with waste type, tank strength, and tank closure.

Underground Waters

Minn. Rules Chapter 7060 classifies all underground waters for use as potable water supplies in order to minimize the spread of pollutants into high quality ground water and to maximize the possibility of rehabilitating degraded waters for their priority use. This regulation will be applicable to the remediation of contaminated ground water at the site by extraction and treatment of ground water until cleanup standards, federal maximum contaminant levels (MCLs), are met at the site boundary.

Regulations found in the Minnesota Department of Health (MDH) Rules:

Water Well Code

Minn. Rules Chapter 4725 will be applicable to construction of new extraction wells. These regulations state that the complete set of plans must be submitted for approval to the Commissioner of the MDH. Location standards for new construction, maintenance and repair of wells and standards for construction appear in the chapter as well.

Residential Lead Abatement

Minn. Statutes Chapter 144.871 to 144.879 and Minn. Rules Chapter 4761 requires that lead levels in soils left on site be remediated

to specific standards for children exposed in residential or playground settings.

Plumbing Code

Minn. Rules Chapter 4715 requires the use of standard plumbing materials and methods which will be applicable to any plumbing installation associated with the ground water extraction, treatment and discharge system.

Regulations found in the Minnesota Department of Natural Resources (DNR) Rules:

Endangered and Threatened Species

Minn. Rules Chapter 6134 provides for the protection of endangered species of flora and fauna in the state. The Minnesota DNR has indicated that the proposed remedy does not adversely effect any endangered species. There is currently no information to indicate that the site is visited by or contains any endangered species.

Regulation found in the Minnesota Department of Labor and Industry Rules:

Health & Safety Requirement

Minn. Rules Chapter 5205 to 5207 provides occupational safety and health standards, including standards for general construction activities. The selected remedial action contractor will develop and implement a health and safety program for its workers.

Right-to Know Standards

Minn. Rules Chapter 5206 covers the employee right-to know standards and requires employers to evaluate their work places for the existence of hazardous substances, harmful physical agents and infectious agent and to provide training and information to those employees covered under this act who are routinely exposed to those substances and agents. Workers at the site will be in contact with hazardous substances during remediation of the site and this regulation would therefore be applicable.

Regulations found in the Minnesota Department of Public Safety:

Gopher One Call - Excavation Notice

Minn. Statutes Chapter 216D is applicable to the excavation of contaminated soils. This regulations provides that an excavator must contact the notification center and provide an excavation or location notice at least 48 hours prior to excavation.

Regulations found in the Minnesota Fire Marshall Rules:

Flammable Liquids

Minn. Rules Chapter 7510 regulates the storage, use and handling of dangerous and hazardous materials, substances, and processes and regulates the maintenance of adequate egress facilities. The re-refinement process for the contaminated materials will require the storage of flammable liquids on site and would be regulated by this rule.

Regulation found in the Minnesota Department of Administration Rules:

Electrical Code

Minn. Rules Chapter 1315 covers all new electrical wiring, apparatus and equipment for electrical light, heat, power and alarm and communications systems must comply with the regulations contained in the 1990 edition of the National Electrical Code (NEC) as approved by the American National Standards Institute, Minnesota Statutes, Section 32.6243 and the Minnesota State Building Code as promulgated by the Commissioner of Administration.

Regulation found in the Minnesota Historical Society Rules:

Historic Sites, field Archaeology

Minn. Statutes Chapter 138.40 requires that action be taken to preserve or recover historic or archaeological data which might be destroyed as a result of site activities. No information exists to indicate that the site has any historic or archaeological significance.

9.3 Cost Effectiveness

The selected remedy is cost-effective in mitigating the principal risks posed by the source material, contaminated soils, sediments and groundwater within a reasonable period of time. Section 300.430(f)(ii)(D) of the NCP requires EPA to evaluate cost-effectiveness. Overall effectiveness is determined by evaluating long-term effectiveness and permanence, reduction of MTV, and short-term effectiveness. Overall effectiveness is compared to cost to ensure that costs are proportional to overall effectiveness. This remedy is cost competitive with the other alternatives presented, provides for long-term effectiveness and permanence, provides fewer short-term risks than the incineration alternatives, provides the potential for a complete reduction in MTV of the contaminants in the source material, and is comparable to the other alternatives with respect to soils and sediments. On the whole, this remedy provides the best balance of tradeoffs with

respect to the cost-effectiveness criteria. The present estimated cost of EPA's selected remedy is $20,800,000. This is a 47% reduction in cost over the original selected remedy.

9.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner at the Arrowhead Refinery site. The reprocessing technology is considered a superior alternative to incineration because it satisfies the statutory preference for permanence and also the intent of the Pollution Prevention Act of 1990, which states, "...pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort....". Energy and possibly lead recovery for beneficial use occupy a higher rung in the pollution prevention hierarchy of waste management options than does incineration, which provides treatment but without the benefit of resource recovery.

MPCA has indicated a preference for pre-treatment of soils prior to landfilling, but has concurred with direct placement of soils and sediments in a RCRA Subtitle D landfill. EPA considers treatment of soils and sediments to be impracticable for the Arrowhead Refinery Site. The contaminant of concern in soil is lead, which is fairly immobile, and present in concentrations which will pose no threat to human health or the environment once placed in a Subtitle D landfill. EPA also considers treatment of the soils and sediments impracticable because the lead levels are not high enough to justify the additional costs involved and because the lead extraction technology contains a number of uncertainties.

9.5 Preference for Treatment as a Principal Element

Treatment of the source material at the Arrowhead site will mitigate the principal threat to human health and the environment. Therefore, the statutory preference for remedies that employ treatment as a principal element is satisfied.

APPENDIX A

ARROWHEAD REFINERY SITE
1986 RECORD OF DECISION

APPENDIX B

ARROWHEAD REFINERY SITE
RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY FOR
ARROWHEAD REFINERY SITE
HERMANTOWN, MINNESOTA

This community responsiveness summary has been developed to document community involvement and concerns during the Amendment of the Record of Decision (ROD) for the Arrowhead Refining Superfund Site in Hermantown, Minnesota, and to respond to comments received in response to the proposed plan during the public comment period.

OVERVIEW

Based upon pre-Remedial Design and supplemental investigations, the U.S. Environmental Protection Agency (USEPA) proposed the following remedy changes with regard to site source material and contaminated soils and sediments. The USEPA proposed replacing the proposed construction of an on-site incinerator to thermally destroy source material, contaminated soils and sediments. The USEPA proposed instead treatment of source material by a chemical treatment process that will extract various contaminants, allowing them to be re-used or recycled, and leaving oils which may be burned as a fuel. If the chemical extraction process should become infeasible, the USEPA recommends incineration of the source material in an off-site, permitted hazardous waste incinerator, with resultant ash (which will contain lead) disposed of in a permitted RCRA Subtitle D landfill provided it passes the Toxicity Characteristic Leaching Procedure (TCLP). USEPA did not propose significant or fundamental changes to the groundwater remedy which included long-term monitoring and maintenance of the groundwater extraction and treatment system already completed at the site.

Community reaction to the proposed ROD amendment broke down into two general categories of comments. Community members who are parties to the CERCLA cost recovery lawsuit relating to the Arrowhead Refinery Site (potentially responsible parties or "PRPs") wanted off-site incineration option for the source material to be considered co-equal with the chemical extraction process proposed by USEPA. If the cost of off-site incineration and landfilling of ash in a Subtitle D facility can be achieved at significantly lower cost than the treatment process, the PRPs want the option of selecting the less expensive remedy.

Residents living close to the Arrowhead Refining Site, while approving the treatment and disposal of the source material, soil and sediment presented to them during the public meeting, evinced great unease about the air quality during the excavation of material preceding off-site treatment. Concerns about the short-term risks involved in the remedial actions led residents to request continuous air quality monitoring. In addition, residents and the local public officials who represent them

expressed the need for assurances that any nearby residents determined by a medical doctor or the Minnesota Department of Health, to be at risk from on-site activities, would be moved, either temporarily or permanently, to protect their health.

Background on Community Involvement

The Arrowhead Refining Superfund Site is located in the City of Hermantown, a suburban community near Duluth, Minnesota. It is located close to the intersection of Miller Trunk Highway and Lavaque Bypass, set partially in a cedar wetland. Property adjoining the site in owned by Gopher Oil and employees work next to the site. Three residences east of the site along Lavaque Bypass are less than 100 feet from Arrowhead's sludge and filter-cake lagoon. Another set of residents, along Rose Road in the path of the ground water flow, is within 300 feet of the site. The property is zoned for industrial use and has had a long history of waste disposal.

During site operations and since the refinery closed down in 1977, many local citizens were not aware of the contamination at the Arrowhead Site. However, as the remedial action at the site has proceeded and the press has covered the site and published photographs and video, many more people have become aware of, and concerned about, site conditions. Local views of the site range from extreme concern to disregard.

Community members who are among the group of potentially responsible parties involved in the cost recovery litigation involving the site have a different perspective, and are for the most part concerned that cleanup costs be kept as low as possible.

Local elected officials have followed developments relating to the site, but have not taken any official positions on EPA and MPCA actions. City leaders have been involved with discussions among USEPA, MPCA and MASC on occasion. Saint Louis County is involved in the site as a PRP for the disposal of used oil from the county fleet.

The local press has actively followed developments relating to the site.

Summary of Public Comments and EPA Responses

I. COMMUNITY CONCERNS

Comment: Residents living close to the site want the EPA to recognize in the Amendment to the Record of Decision (AROD) that there are "sensitive populations" (i.e., a resident with severe pulmonary problems) who are at increased risk from site related activities.

EPA Response: The USEPA has reviewed the Health Assessment prepared by the Minnesota Department of Health (MDH) under contract with the federal Agency for Toxic Substances Disease Registry (ATSDR). The ATSDR Health Assessment, which is the federal assessment of actual or potential health impacts of the Arrowhead Refining site, as well as additional correspondence from MDH, have taken into account residents' concerns about possible adverse impacts of site activities on populations with increased susceptibility. The AROD requires the preparation and implementation of an EPA - approved air quality monitoring plan for the protection of local residents.

Comment: Residents living close to the site request air quality monitoring as suggested by the MDH any time materials will be moved on or near the site. They request testing before, during and after any site activity or remediation process, as well as placement of monitors both on-site and off-site.

EPA Response: The preparation and implementation of an EPA-approved air quality monitoring plan is a requirement of the AROD. The specifics of the monitoring plan have not been determined, but the EPA will take into account residents at increased risk and community preferences before approving a final monitoring plan.

Comment: Residents requested that air quality monitoring data be available in the Administrative Record (Duluth Public Library) or Hermantown City Hall.

EPA Response: EPA will forward copies of quality assured/quality controlled air quality monitoring data to the Administrative Record repository in the Duluth Public Library. Data from previous air quality monitoring events is available upon request from the MPCA.

Comment: A local pulmonary physician provided a health evaluation of one resident, indicating that the resident's severe respiratory difficulties put him at significant risk from site-related activities, including movement of uncontaminated soils that produce dust.

EPA Response: EPA has received the physician's assessment of the resident's health status and will assure that suitable actions are taken to protect that resident's health during on-site activities.

Comment: Residents requested that persons at significant risk from site-related activities be relocated either temporarily or permanently (through a buy-out of property) before on-site work begins.

EPA Response: The AROD requires measures to protect the health of

nearby residents during on-site work. These measures may include the temporary relocation of residents determined by a medical doctor and/or the Minnesota Department of Health to be at significant risk from on-site activities.

Comment: A resident at significant risk from on-site activities stated that he preferred a buy-out of his property to temporary relocation before and during on-site activities.

EPA Response: The EPA notes the resident's preferences; however, given that risk is due to dust and emssions from excavation and treatment which is expected to last a relatively short period of time, only temporary relocation is warrented, especially since this will be a clean closure site.

Comment: A resident asked that his up-gradient well be tested four times a year to assure that his drinking water is safe. His particular concern is movement of contaminated water via fractured bedrock.

EPA Response: Long-term monitoring and maintenance is a requirement of the AROD, and regular testing of the ground water will continue at the site. The long-term monitoring plan might include testing of residential wells; however, EPA might not require quarterly sampling. Currently, the MPCA is checking the well twice a year which EPA considers to be adequate.

Comment: A resident asked that well depth should be regularly checked to make sure that the French drain system installed on-site is not causing draw-down or depletion of residential wells.

EPA Response: Monitoring of well depth and draw-down has been conducted by the potentially responsible parties and the MPCA since the construction of the French drain. No private well has been adversely affected by the French drain system. MPCA has measured the draw-down every other month and will continue to monitor draw-down in the future.

Comment: A resident wanted to know which government or private entity is responsible for maintenance of the EPA ditch dug by the U.S. Coast Guard. He said that water flow is diverted from the Lavaque Bypass culvert, the ditch collapses, and water backs up into ditches on the Lavaque Bypass instead of flowing in the correct direction.

EPA: The ditch system was rebuilt in 1993 and should not be causing any problems for the residents now or during the cleanup process. After that, local government (either the county, city, or township) will have responsibility for ditch maintenance.

Comment: A resident requested that the wetland area destroyed by waste disposal at the Arrowhead Refining site be restored.

EPA Response: After remediation on-site is complete, an attempt will be made to leave the site in a condition which will facilitate a return to its natural state. Additional work specifically directed toward restoration may not be necessary, but EPA will consider community preferences about restoring the wetland on the property.

Comment: A resident wondered why an environmental impact statement was not completed for the Arrowhead Refinery site.

EPA Response: When Arrowhead Refining was established and waste disposal had taken place, no regulations existed requiring Environmental Assessment Worksheets (EAW) or Environmental Impact Statements (EIS) to site facilities in Minnesota. NO EAW or EIS is required in order to conduct remediation activities on the site, since the process under CERCLA for selecting the appropriate remedy is virtually the same as the EIS process.

Comment: Residents want the petroleum-contaminated soil stockpiled on-site to be removed from the site and treated.

EPA Response: Petroleum-contaminated soils discovered upon installation of the French drain system will be cleaned up under the authority of the MPCA's Tanks and Spills program. It is anticipated that MPCA will issue a Corrective Action Order to clean up the contaminated soil.

Comment: A resident outlined conditions he expected to have fulfilled if the EPA approves a plan to protect nearby residents at significant risk that involves temporary relocation. Among the conditions: two-day notice before any work is done on site to allow the resident and family to plan and pack; soil and air testing on the resident's property to assure that contaminants have not affected the property; a two-day period for resettlement after work is completed; security guards 24 hours per day to protect the resident's property; and a $500 per day payment for every day the family is absent from home (to be paid to the resident every seven days).

EPA Response: The conditions of any temporary settlement of residents at significant health risk from on-site activities will be negotiated with the residents, consistent with the guidelines set by the Federal Emergency Management Administration, and if applicable, 49 CFR Part 24.

II. PRP CONCERNS

Comment: Several PRPs urged EPA to participate in a mixed funding settlement with the PRPs.

EPA Response: The purpose of the public comment period is to solicit remarks from the community that pertain specifically to

remedy selection. Therefore, a discussion on mixed funding or any other Administrative/Legal settlement issue is inappropriate in this forum and will not be addressed in this responsiveness summary.

Comment: Several commentors have urged EPA to consider off-site incineration as a coequal option to reprocessing. The Minnesota Arrowhead Site Committee (MASC) stated that it is arbitrary and capricious for the EPA not to consider off-site incineration as a co-equal remedy to reprocessing.

EPA Response: Off-site incineration is subject to the nine criteria analysis in this AROD (please see Table 6-1 in the AROD for a full discussion of the nine criteria). On balance, it is protective of human health and the environment and complies with ARARs, as is the reprocessing alternative. The difference between the two is found in the five balancing criteria. The reprocessing technology is potentially superior with respect to reduction in lead toxicity, mobility and volume, because there is the possibility of lead recovery in a secondary smelting facility for beneficial reuse, whereas, incineration will produce a lead-laden ash which will require disposal. The short term remedial action risks are also superior for reprocessing, which is a fairly soft technology which has minimal health risks associated with it. Incineration, on the other hand, poses the possibility of site worker exposure to hazardous emissions in the event of a process upset (such as might happen during a power failure). The cost of the reprocessing technology is $2 million less than off-site incineration. Finally, Section 121 of CERCLA mandates that the remedial action must utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Additionally, the Pollution Prevention Act of 1990 states, "..pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort...". The reprocessing technology turns hazardous waste into saleable fuel for energy recovery. The incineration alternative simply destroys the waste without the benefit of energy recovery/reuse. It is therefore the EPA's judgment that the reprocessing technology is superior to the incineration technology, because it satisfies the intent of these statutes.

Comment: One PRP commented that EPA's failure to evaluate an on-site soil cover for the contaminated soils and sediments was arbitrary and capricious. The PRP claimed that the lead cleanup level for soil of 500 ppm was low and should be adjusted upward based on a Biokinetic Uptake Model (UBK) which the PRP contracted to be performed.

EPA response: This on-site cover alternative was evaluated in the 1986 ROD and was rejected because this remedy is not

permanent. There is a statutory preference for remedies which are permanent as mentioned above. EPA and MPCA did not believe it was warranted to re-evaluate a simple soil cover in light of this.

With respect to the PRP UBK model, the EPA and MPCA do not agree with the baseline assumptions that were utilized in the PRPs' UBK model; specifically, that the exposed person would be an adult under a commercial/industrial exposure scenario. The 500 ppm cleanup level for lead is based upon the UBK model and coupled with exposure assumptions which the Agencies consider to be more appropriate to this site. The most notable of the assumptions was that exposure to soil would be under a residential rather than a commercial/industrial exposure scenario. While the Arrowhead site itself is commercial, it exists in a residential neighborhood. The Agencies therefore believed it prudent to consider the possibility of children accessing the site and being exposed to the lead in soil under a residential exposure scenario. There is precedent for using this approach elsewhere in Minnesota and in Michigan.

Comment: One PRP commented that EPA's failure to reevaluate groundwater criteria and alternative points of compliance is arbitrary and capricious.

EPA Response: EPA has evaluated and made changes to the groundwater criteria and point of compliance. It is important to note that these changes are not fundamental or significant changes to the remedy and are therefore not considered to require an amendment to the ROD; however, they are mentioned in the body of the AROD. The groundwater aquifer will be restored to MCLs rather than to a 10^{-6} health based levels in accordance with EPA policy and guidance. The point of compliance is now located at the site southern boundary at the french drain well head.

APPENDIX C

ARROWHEAD REFINERY SITE
ADMINISTRATIVE RECORD INDEX

ADMINISTRATIVE RECORD INDEX
ARROWHEAD REFINERY SITE
DULUTH, MINNESOTA

FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
	1	86/09/16	Letter re: comments on public meeting held 9/15/86	Oberstar, J.,9th District Congress	Beck, J., U.S. EPA	Correspondence	
	1	86/09/16	Letter re: Draft ROD	Carlson, W., Citizen	Kalitowski, T.,MPCA	Correspondence	
	3	86/09/19	Letter re: comments on public meeting held on 9/15/86	Carlson,W., Citizen	Beck, J.,U.S. EPA	Correspondence	
	1	86/11/26	Letter re: Strategy to resolve differences concerning the Record of Decision	Adamkus, V., U.S. EPA	Kalitowski, T., MPCA	Correspondence	
	1	86/04/22	Memo: re: Residential Well Sampling results	Von Huben, H., U.S. EPA	VanderLaan, Chief SMS	Memorandum	
	1	86/09/29	Memo re: Draft ROD	Sutfin, C., U.S. EPA	Constantelos, B.,WMD	Memorandum	
	1	86/11/24	Memo re: State Concurrence w/ Arrowhead	Constantelos, B. U.S. EPA	Adamkus, V., U.S. EPA	Memorandum	
	12	00/00/00	Responsiveness Summary Arrowhead Refinery Site	U.S. EPA		Other	
	4	00/00/00	Background information Remedy Selection Approach Procedure	U.S. EPA		Other	
	1	86/09/18	Public Announcement re: Public comment period extended	Beck, J., Bartman, F. U.S. EPA	Interested Persons	Public Comments	
	1	86/09/15	EPA meeting registration form w/handwritten comments	Nelson, R., Citizen	U.S. EPA	Public Meeting	

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ARROWHEAD REFINERY SITE
DULUTH, MINNESOTA

FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
	374	86/08/25	Public Comment Remedial Investigation Report (2 of 2) Appendices	Ch2M Hill	EPA	Reports/Studies	
	399	86/08/27	Public Comment FS	CH2M Hill	EPA	Reports/Studies	
	61	86/09/30	ROD - Remedial Alternative Selection	U.S. EPA		Reports/Studies	

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ARROWHEAD REFINERY
UPDATE NO. 1
HERMANTOWN, MINNESOTA

FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
	3	88/01/20	Memorandum re: Meeting to discuss future activities and objectives for the Arrowhead Refinery Project	Fred Bartman		Memorandum	1
	1	88/04/12	Press Release "Arrowhead Superfund Project On-Site Work Scheduled"	MPCA		Press Release	2
	113	07/07/87	Agency Review Final Work Plan - Fieldwork Design Investigation	CH2MHILL		Report/Studies	3
	357	87/08/21	Quality Assurance Project Plan - Fieldwork Design Investigation	CH2MHILL		Report/Studies	4
	70	87/09/17	Agency Review Final Work Plan - Materials Handling/Thermal Treatment Design Investigation	CH2MHILL		Report/Studies	5
	165	88/02/10	Quality Assurance Project Plan - Materials Handling/ Thermal Treatment Design Investigation	CH2MHILL		Report/Studies	6

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UPDATE NO. 2
ARROWHEAD REFINERY
HERMANTOWN, MINNESOTA

FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
	4	86/08/05	Letter re: USEPA documentation of the release and threatened release of hazardous substances, pollutants, and contaminants at the Arrowhead Refinery	Basil Constantelos, USEPA	Various	Correspondence	1
	4	89/03/27	Letter re: Status of the USEPA's and the MPCA's activities at the Arrowhead Refinery site	Rhonda McBride, USEPA	Various	Correspondence	2
	5	91/03/29	Letter re: MASC's effort to reach agreement with the United States EPA regarding Arrowhead Refinery Superfund Site further remedial activities	Dennis Reis, Sidley & Austin	Ullrich/Niedergang, USEPA	Correspondence	3
	6	91/04/30	Letter re: Response to 3/29/91 letter on behalf of the MASC in regards to Arrowhead Refinery Superfund Site	David Ullrich, USEPA	D. Reis, Sidley & Austin	Correspondence	4
	48	86/09/15	Meeting notes re: Public Meeting Arrowhead Superfund Site	Braden, Danielson, Undeland & Everson	USEPA	Meeting Notes	5
	8	86/07/02	Memorandum re: Health Assessment: SI-86-114, Arrowhead Refinery	Acting Director, Office of Health Assessment	Luis Fabinski, USEPA	Memorandum	6
	146	00/00/00	Attachments for B.E.S.T. Glassware Test Report	RCC	CH2MHILL	Report/Studies	7

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UPDATE NO. 2
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HERMANTOWN, MINNESOTA

FICHE/FRAME	PAGES	DATE	TITLE	AUTHOR	RECIPIENT	DOCUMENT TYPE	DOCNUMBER
	38	00/00/00	National Priorities List Site - Arrowhead Refinery Co.	USEPA		Report/Studies	8
	42	84/10/10	Final Community Relations Plan			Report/Studies	9
	52	87/10/15	Technical Memorandum re: Thermal Treatment Technologies available for Testing and Remediation of Contaminated Sludge, Soil and Sediment at the Arrowhead Refinery	Steve Keith, CH2MHILL	Fred Bartman, USEPA	Report/Studies	10
	41	89/08/00	B.E.S.T. Glassware Test Report for CH2MHILL	Resources Conservation Company	CH2MHILL	Report/Studies	11
	234	89/12/27	Design Investigation Treatability Study Volume 2: B.E.S.T. Glassware Test Report	CH2MHILL	USEPA	Report/Studies	12
	66	89/12/27	Design Investigation Treatment Study Volume 1: Treatability Study Report	CH2MHILL	USEPA	Report/Studies	13
	194	90/04/30	Field Design Investigation Volume 1	CH2MHILL	USEPA	Report/Studies	14
	534	90/04/30	Fieldwork Design Investigation Volume 2	CH2MHILL	USEPA	Report/Studies	15
	90	90/04/30	Fieldwork Design Investigation Volume 3	CH2MHILL	USEPA	Report/Studies	16

U.S. EPA ADMINISTRATIVE RECORD
ARROWHEAD REFINERY SITE
HERMANTOWN, MINNESOTA
UPDATE #3
02/08/94

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	#
1	00/00/00	Kelly, J., U.S. EPA	Addressees	104(e) Request for Information Letter w/Attachments	14
2	00/00/00			Chart: National Primary Drinking Water Standards	1
3	00/00/00	Atlas, R.		Journal Article: "Bioremediation of Fossil Fuel Contaminated Soils" (In Situ Bioreclamation)	3
4	00/00/00	MPCA	U.S. EPA	MPCA Procedures for Establishing Soil Cleanup Levels, Version 1	6
5	00/00/00	Tricopler, D.	Penning, J., MPCA	Memorandum re: Comments on Soil Cleanup Goals	2
6	00/00/89	Evans, J.		Journal Article: "Chemistry of Metal Retention By Soils" (Environmental Science & Technology)	2
7	00/00/89	Mueller, J., et al., U.S. EPA		Journal Article: "Creosote Contaminated Sites: Their Potential for Bioremediation" (Environmental Science & Technology)	3
8	09/01/89	U.S. EPA	U.S. EPA	"Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites" (OSWER Directive #9355.4-02)	3
9	11/27/89	Abbott, C., et al.		Paper: "Use of Bioassays to Monitor Polycyclic Aromatic Hydrocarbon Contamination in Soil" (Presented at Superfund '89, Proceedings of the 10th National Conference)	3
10	01/26/90	[redacted]	U.S. EPA	Supplement to Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER Directive #9355.4-02A)	4
11	03/27/90	[redacted] Dept. of Health		Comments on Soil Exposure Guidelines	3
12	04/04/90	Schmitt, M., MPCA	Penning, J., MPCA	Memorandum re: Review of Soil Cleanup Goals	4
13	04/12/90	Stark, S., MPCA	Penning, J., MPCA	Memorandum re: Review of Soil Cleanup Goals	3
14	08/01/90	Willet, B., MPCA	Addressees	Memorandum re: MPCA's ARARs/Statutes	23

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
15	10/11/90	Pennino, J., MPCA	Schmitt, M., MPCA	Memorandum re: Response to Comments on Soil Cleanup Goals	3
16	11/00/90	U.S. [redacted]		Procedure: Method 3540A Soxhlet Extraction, Revision 1	103
17	12/20/90	Hurst, P., U.S. EPA	Smith, E., U.S. EPA	Memorandum re: Carcinogenic Information for Polycyclic Aromatic Hydrocarbons w/Attachment	3
18	00/00/91	Dec, K., et al.		Journal Article: 'Bound Residue Formation in PAH Contaminated Soil Using Pharaerochaete Chrysosporium' (Hazardous Waste & Hazardous Materials)	12
19	00/00/91	Aggarwal, P., et al.		Journal Article: "Monitoring In Situ Biodegradation of Hydrocarbons by Using Stable Carbon Isotopes" (Environmental Science & Technology)	7
20	00/00/91	Middleton, A., et al.		Journal Article: "The Influence of Soil Composition on Bioremediation of PAH-Contaminated Soils" (Remediation)	22
21	01/08/91	Minnesota Office of Administrative Hearings	MPCA	Report: "In the Matter of Proposed Permanent Rules Governing Standards and Abatement Methods for Lead in Bare Soil on Playgrounds and Residential Property" w/Attachments	34
22	01/30/91	Arnold, F., Minnesota Dept. of Health	Pennino, J., MPCA	Memorandum re: Comments on Soil Cleanup Guidelines	7
23	04/11/91	Arnold, F., Minnesota Dept. of Health	Pennino, J., MPCA	Memorandum re: Soil Cleanup Guidelines	1
24	06/14/91	Reis, D., Sidley & Austin	Branigan, T., U.S. EPA	Letter re: Minnesota Arrowhead Site Committee's Comments to the Section 106 Administrative Order of May 3, 1991 w/Attachments (CBI Pending: This Document is of a Confidential Nature and Has Not Been Copied for Physical Inclusion Into the AR)	62
25	07/00/91	[redacted] of Tennessee	Gas Research Institute	Report: "Treatability and Scale-Up Protocols for Polynuclear Aromatic Hydrocarbon Bioremediation of Manufactured Gas Plant Soils, Volume I, Final"	148

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26	07/21/91	[redacted] U.S. EPA	Branigan, T., U.S. EPA	Letter re: Comments on the "Evaluation of U.S. EPA Choice of Remedy for Source Materials." CBI Pending: This Document is of a Confidential Nature and Has Not Been Copied for Physical Inclusion Into the AF)	5
27	09/09/91	Clay, D., U.S. EPA	Addressees	"Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites, Update" (OSWER Directive #9355.4-02, September 1989)	4
28	10/22/91	Smith, E., U.S. EPA	File	Memorandum re: Groundwater Extraction and Treatment System Construction Schedule	1
29	12/17/91	SCOVA Corporation	U.S. EPA	Treatability Study, Final	22
30	02/10/92	Bollag, J.		Journal Article: "Decontaminating Soil With Enzymes: An In Situ Method Using Phenolic and Anilinic Compounds" (Environmental Science & Technology)	5
31	02/13/92	Villas-Horns, C.	Haberman, K., and Penniro, J., MPCA	Memorandum re: Review of "Procedures for Establishing Soil Cleanup Levels"	6
32	04/00/92	U.S. EPA		Drinking Water Regulations and Health Advisories	13
33	07/09/92	Cognis, Inc.	U.S. EPA	Soil Remediation Investigation, Phase I	13
34	07/22/92	Truax, R., Remediation Technologies, Inc.	Gentzsch, E., MPCA	Letter re: RETEC's Review and Comments on the Draft Soil Cleanup Levels w/Attached Technical Memorandum Concerning Soil Cleanup Levels for Burlington Northern Railroad Car Shops	33
35	09/04/92	Straitz, A., MPCA	Smith, E., U.S. EPA	Letter re: Soil Cleanup Numbers w/Attachment	4
36	09/21/92	Vanderpool, L., U.S. EPA	Smith, E., U.S. EPA	Memorandum re: Review of the MPCA Model for Determining Soil Cleanup Levels Based Upon Potential Contaminant Migration to Groundwater	1
37	10/13/92	[redacted]	Smith, E., U.S. EPA	Letter re: Evaluation of Soil Cleanup Goals w/Attachments	0
38	10/22/92	[redacted] Dept. of the Army	Rosano, D., MPCA	Letter re: MPCA Procedures for Establishing Soil Cleanup Levels w/Attachments	13
39	10/28/92	Straitz, A., MPCA	Smith, E., U.S. EPA	Letter re: Lead Cleanup Numbers	2

DOC#	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
40	10/30/92	[redacted]	Smith, E., U.S. EPA	Memorandum re: Review of MPCA's "Procedures for Establishing Soil Cleanup Levels"	5
41	11/11/92	[redacted] Steel	Smith, E., U.S. EPA	Letter re: Minnesota Arrowhead Site Committee's Proposed Supplement to the Source Materials Order Scope of Work	1
42	11/18/92	Kelley, J., U.S. EPA	Pulford, B., MPCA	Letter re: U.S. EPA's Review of MPCA Model for Calculating Soil Cleanup Levels w/Attachments	10
43	11/23/92	Smith, E., U.S. EPA	Borovsky, J., Barr Engineering Company	Letter re: U.S. EPA's Comments on the Draft Statement of Work for the Sludge and Filter Cake Remedy	1
44	12/23/92	Pamuka, J., MPCA	Ambrose, R., U.S. EPA	Letter re: Response to Review of MPCA's "Procedures for Establishing Soil Cleanup Levels," w/Attachments	3
45	01/00/93	Barr Engineering Company	U.S. EPA	Report: Biological Treatability Study, Volume II: Appendices A, B, C, D, E (Draft)	819
46	01/06/93	Kelley, J., U.S. EPA	Pulford, B., MPCA	Letter re: Application of MPCA Procedures for Establishing Soil Cleanup Levels and U.S. EPA's Position on Further Use of the Model on NPL Sites	3
47	01/08/93	ABB Environmental Services Inc.	U.S. EPA	Report: Biological Treatability Study Arrowhead Soil, Filter Cake, and Sludge (Draft)	222
48	01/14/93	Branigan, T., U.S. EPA	Comstock, R., Dorsey & Whitney	Letter re: Minnesota Arrowhead Site Committee's Proposed Study of Alternative Remedial Technologies	2
49	01/19/93	Smith, E., U.S. EPA	Draper, D., U.S. EPA	Memorandum re: Technical Assistance for the Review of the Bioremediation Treatability Study	1
50	02/01/93	[redacted] MPCA	Kelley, J., U.S. EPA	Letter re: MPCA's Model to Determine the Potential for Contaminants to Leach Soil Into the Ground Water	3
51	02/03/93	[redacted]	Borovsky, J., Barr Engineering Company	Letter re: Proposed Changes to the ROD By Issuance of an Explanation of Significant Differences	2

DOC#	DATE	[redacted]	RECIPIENT	TITLE/DESCRIPTION	PAGES
52	02/11/93	[redacted]	Smith, E., U.S. EPA	Memorandum re: Review of MPCA Procedures for Establishing Soil Cleanup Levels	3
53	02/12/93	[redacted]	Smith, E., U.S. EPA	Memorandum re: Review Comments on the "Biological Treatability Study--Arrowhead Soil, Filter Cake, and Sludge--Draft"	9
54	03/04/93	Kelley, J., U.S. EPA	Pulford, B., MPCA	Letter re: Several Issues Brought Up in the MPCA Letter of February 1, 1993 Concerning the Lead in Soil Cleanup Levels	7
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ARROWHEAD REFINERY SITE
HERMANTOWN, MINNESOTA
UPDATE #3
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